THE
TROPICAL AGRICULTURIST:
JOURNAL OF THE
CEYLON AGRICULTURAL SOCIETY.

VOL. XLVI. COLOMBO, MARCH, 1916. **No. 3.**

THE FACTS AND HOW TO DEAL WITH THEM.

Now that a School of Tropical Agriculture has been opened at Peradeniya whereat students can be taken through a course of scientific training, it is pertinent to enquire wherein scientific agriculture differs from unscientific. There exists a belief not so generally held as at one time of a definite dividing line between the two, and this is sometimes quoted against scientific methods as being unpractical and costly, but in reality there is no such dividing line. The history of agriculture, it has been truly said, is the history of the human race. Knowledge that is in the keeping of science to-day becomes common property in the course of time. We can trace the process in the case of manuring. Many of the cultivating tribes of Africa for instance do not know that goat and cattle manure is good for crops and therefore never use it. As compared with them the dung farmers of the middle ages or the untutored village cultivators of the east are in a sense men of science, because, reduced to its simplest terms, science is knowledge of nature. The discoveries of LAWES and GILBERT were at first only studied by scientific men, but the advantages of artificial manures became in time generally understood. In some countries we may be said to be now in the green manure era which may lead on to the use of some concentrated form of bacterial activity such as bacterized peat, the use of which is at present being investigated in scientific circles.

Another example of what the application of scientific discoveries has been able to effect is the replacing of extensive

culture, that is—cropping of a piece of land till it is exhausted as in the case of the Ceylon chena system, with intensive culture—the cropping of a piece of land repeatedly for an indefinite period. For the scientific spirit, said a recent writer in a London Journal,* the only question is what are the facts and what is the best manner of dealing with them?—a formula to which the whole difference between scientific and unscientific agriculture may be referred. It is a spirit totally opposed to that of prejudice; it involves the scrapping of theories however fond the moment they are found to be fallacious; it demands detachment, precision and patience in the pursuit of truth. It is not, however, always easy to come by the facts because they are often described in language that can only be understood by taking courses of instruction in the class room that will reveal the meaning of the terms and symbols used and the nature of the forces and bodies referred to. The trained agriculturist with knowledge of the facts occupies from the first an advantageous position and is able to anticipate the man who depends solely upon his own experience.

But it is demanded of the scientific man that he shall also know the best way of dealing with the facts, because agriculture is not only a science but also an art and an industry. His knowledge gained in the class room must first undergo as it were a process of vulcanization. It must come in contact with human realities, be torn and tempered with criticism and experience, before it acquires a permanent set. The best way of dealing with the facts will not be the same in all cases, and this is especially the experience of the agriculturist who knows that local circumstances must be studied and allowed for; perhaps even fables accepted if results are to be secured. Prejudice becomes for him indeed a fact to deal with just as much as any discovery in the laboratory. The main thing is that he should not permit it to become subjective and that he chooses carefully the sources of information upon which he relies to enable him to distinguish facts from fables.

R. N. L.

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* THE TIMES.

COCONUTS.

COCONUTS IN THE SEYCHELLES.

The following extracts are taken from the interesting report by the Curator of the Seychelles Botanic Gardens on the Agriculture and Crown lands of the Colony for 1914 :—

As anticipated in my report for last year, the rise in the output of coconuts is proceeding by leaps and bounds. The crop for the year under review amounts to 31,000,000 nuts, being greater by 5,000,000 nuts than the crop for the preceding year. This result bears testimony to the greater attention which is paid by planters to their coconut plantations. The crop will continue to increase for a long time, as during the last five years nearly 100,000 more coconut trees were set out and these trees will be bearing in five years. The present increase is solely due to the plantations having been cleaned regularly and freed of the fungus and beetle diseases to some extent. The leading planters are also taking the trouble to manure with compost, seaweeds, cow-dung, etc., and the results already obtained will gradually induce them to use guano, green manures and chemical fertilisers. A good deal of subsoiling by hand has also been done, but unfortunately the use of explosives for the breaking of the hardpan a few inches underground has not been attempted owing to the difficulty of getting explosives at a cheap price. The practice of digging trenches in which all the refuse is thrown in is more and more largely adopted on level land.

The question of selection of varieties of coconuts is not lost sight of by a few planters. This selection depends, however, on so many factors that little progress in the right direction has been made. One of these factors, unobserved hitherto, is the number of female flowers produced by the different varieties, which is very variable. Mr. Petch, of Ceylon, has called in December, 1913,* the attention of planters to this subject. The flowerings do not take place regularly in Seychelles and this accounts for the irregularity of the crop, which generally reaches a maximum in July and drops to a minimum in February. The number of female flowers per bunch does not vary on the same tree, but during the months of minimum crop there are much less inflorescences produced by the tree, notwithstanding the weather conditions, and many of these contain no female flower at all. It is from trees producing the greatest number of female flowers per bunch and per annum that seed nuts should be selected. Admitting that the number of ripe nuts per tree is a sufficient guide for selection, there is however another factor, i.e., the fall of immature nuts, which has to be taken into consideration and which seems also to be of a character proper to some kinds. Many trees which drop their nuts before maturity seem to recover from this defect during the months of maximum production and should not be necessarily discarded in

* The Flower of the Coconut, by T. Petch. Vol. XLI., No. 6, p. 449.—Ed. T.A.

the work of selection. From a few observations made when the trees are young and in their third year of blossoming, the natural tendency of the trees can be well determined, and there is no need to wait till they are old and produce their full crop of ripe nuts, to carry on the work of selection. For trees that flower after their seventh year of growth the question of gaining time in the work of selection is to be seriously considered.—AGRICULTURAL NEWS.

PHILIPPINE COPRA TRADE IN 1914.

The Report of MR. CONSUL-GENERAL J. B. REINTIERS on the trade of the Philippine Islands, just issued, states that there was an increase in the quantity of copra exported in 1914, but a decrease in its value due to the fact that over 60 per cent. of the entire export was shipped during the latter half of the year, when prices, which had fallen sharply in foreign markets immediately after the outbreak of war, had not recovered. Destinations of principal exports of copra were as follows :—

To	£.
France	726,000
United States	335,000
Spain	204,000
Germany	160,000
United Kingdom	100,000

The increase in the export of coconut oil covers two-thirds of the loss in value of copra exported. This new item has been of rapid growth. In 1912, the export was 660 kilos, or little over ½-ton, valued at £8 ; in 1913 it was 4,509 tons valued at £238,821 ; while in 1914 it had risen to 10,748 tons valued at £545,663, the whole of which, with the exception of £2,500 shipped to Hongkong, went to New York.

Another new item of export, a by-product of the oil, is coconut cake, the export of which in 1913 was 2,696 tons, valued at £22,828. The entire export which had increased by 50 per cent. in 1914 went to Hamburg. The year 1914 marked the full recovery of the coconut plantations from the effects of the drought and typhoons of 1911-12, and a larger production was looked for.

This was, however, naturally curtailed by the low price to which copra fell. A marked improvement in the general situation was, however, noticeable during the last three months of the year. Prospects for the coming crop are good, though in some places there is fear that continued dry weather may have retarded the growth of the nuts.

The CONSUL-GENERAL adds that the local oil mill continues to be a strong buyer, and when a further mill, now under construction near Cebu, is completed, some reduction may be looked for in the export of copra, which may, however, be equalised by an increased production.—INDIAN TRADE JOURNAL.

MANURING OF COCONUTS AT NEVIS.

The following table is of interest in obtaining an insight into the progress of the experiment :—

Manure.	Nuts collected per tree.	Difference between number of nuts at end and at beginning of experiment.	Nuts produced during period of experiment.
1. No manure ...	29·6	— 6·0	23·6
2. Pen manure ...	29·5	— 1·3	28·2
3. Tankage ...	26·2	+ 5·3	31·5
4. Phosphate and potash ...	24·9	+ 0·4	25·3
5. Nitrogen ...	21·7	+ 2·2	23·9
6. Phosphate, potash and nitrogen ...	25·0	+19·0	44·0
7. Phosphate ...	19·9	+ 1·8	21·7
8. Cotton seed meal ...	26·6	+ 4·2	30·8

While it would be a difficult matter to compare the results of one manure against another, it will be seen that the manures have all had a beneficial effect on the trees so far as number of nuts is concerned, for in none of the manured plots, except pen manure, is the average number of nuts per tree, at the close of the experiment, below what it was when the experiment was started. The case is otherwise with the no-manure plot.

During the past two years it was observed that the individual tree is producing a smaller number of nuts each year, and it would appear that manure would maintain the yield, and that manuring is both desirable and necessary.—Agricultural News.

ANALYSES OF QUEENSLAND-GROWN COPRA.

1. Sample from the State Nursery, Kamerunga, Cairns:—Nett weight received, 10·5 oz.; moisture, 5·2 per cent.; oil, 62·8 per cent.

2. Small Nut ("King"): Per cent. of air-dry material in green kernel, 48·0; per cent. of oil in air-dry kernel, 60·4. Large Nut: Percentage of air-dry material in green kernel, 75·0; per cent. of oil in air-dry kernel 39·5. The kernel of the smaller nut (rather unripe) of "King" variety contained 60·4 per cent. of oil in the air-dry substance, which is a fairly high amount; whereas the common variety only contained 39·5 per cent.

3. Four nuts sent, but only three received; all analysed separately. 1st Nut: Per cent. of air-dry material in green kernel, 44·6; per cent. of oil in dry kernel, 41·0. 2nd Nut; Per cent. of air-dry material in green kernel, 46·6; per cent. of oil, 60·0. 3rd Nut (very green): Per cent. of air-dry material in green kernel, 20·0; per cent. of oil, 45·0.

4. Sample from Double Island, near Cairns: Commercial copra—Moisture, 4·7 per cent,; oil, 57·8 per cent.; consequently very fair quality. Percentage of oil in copra: The average yield of oil from sundried copra in the Philippines is 60·3 per cent.; Cuba, 63 per cent.; West Indies generally, 61·8 per cent.; Mauritius, 52 per cent.—Queensland Agricultural Gazette.

RUBBER.

NOTE ON THE COMPOSITION OF AN OLD RUBBER TREE.

The tree, which was 11 years old and measured 34 inches in circumference at 3 feet from the ground, was cut out before leaf-fall began and was kindly sent for analysis by MR. R. V. GRIMWOOD at my request, and was received on 13th January, 1916.

The weight of the trunk was 820 lb., and the side branches and leaves 305 lb., or a total of 1,125 lb., practically half a ton.

On burning the trunk and branches, etc., separately the former yielded 13 lb., and the latter 19 lb. of crude ash respectively, giving 3·65 lb. and 7·75 lb. of pure ash, or 0·445 per cent. and 2·54 per cent. on the stem and branches. The total ash was 11·40 lb., equivalent to 1·01 per cent. on the whole tree. The total ash in 100 trees per acre would be 1,140 lb., all of which has been taken up from the soil, and partly from the annual leaf-fall during the 11 years of growth.

The ash consists chiefly of carbonates and phosphates of Lime, potash and soda. The phosphoric acid is about one-third of the Lime, and one-half the potash content.

The average percentage of soda is higher than the potash which is unusual, and would indicate a deficiency of available potash in the soil in which the tree was grown.

The following table shows the composition of the ash as regards its chief constituents, the total amount per acre allowing 100 trees, and the average amount of each constituent absorbed annually.

Ash Constituents.	Wood.	Branches and Leaves.	Average.	Total per acre 100 Trees.	Average amt. absorbed per annum.
	%	%	%	lb.	lb.
Lime ...	21·20	20·00	20·60	235	21·3
Magnesia ...	6·04	6·77	6·40	73	6·6
Potash ...	14·96	10·34	12·65	144	13·1
Soda ...	14·79	15·69	15·24	174	15·8
Phosphoric Acid ...	7·80	6·53	7·16	81	7·3
Sulph. Acid ...	2·88	2·54	2·71	31	2·8

Dry rubber contains only about 0·32 per cent. of ash, and 400 lb. per acre would only remove about 1¼ lb. of mineral matter, a quantity that is negligible.

Liming at 5 or more cwt. per acre as is now commonly done as a preparation for manuring will supply ample of this constituent for some years, though the annual loss of lime in drainage is considerable.

The actual potash, soda and phosphoric acid requirements would be supplied by an annual application of 30 lb. of sulphate of potash, 70 lb. of nitrate of soda, and 33 lb. of steamed bone meal; and in most soils these quantities would be easily liberated by forking and general cultivation.

Heavy manurial applications would tend to result in loss by drainage, unless the mixtures were of a slowly acting character.

M. KELWAY BAMBER.

JAPAN RUBBER TRADE IN 1914.

In my contribution to the April issue of the INDIA RUBBER WORLD I endeavoured to give as complete statistics as possible of the rubber trade of this country during the calendar year 1914, but I will take up the subject again to give your readers more detailed information which I have obtained from statistics published recently by our Department of Finance and by the Customs authorities in Kobe.

Although no large rubber factories existed here during 1914, there were in operation quite a number of small plants, with the result that our consumption of crude rubber increased substantially in spite of war conditions and the incidental hindrance to commerce. The war embargo on rubber injuriously affected our rubber manufacturers. It stopped the supplies of crude rubber we were in the habit of obtaining from Singapore, until the latter part of October, when small quantities were obtained from the Straits Settlements port. The decrease in arrivals of crude rubber was soon felt by our manufacturers, for here in Japan it is not customary to speculate in crude rubber, especially when prices have a downward tendency. Purchases are made only as the material is needed; so that when the embargo came there were not large supplies of crude rubber on hand in this country.

Singapore being practically closed to us, we endeavoured to obtain crude rubber from Dutch India, only to find that the entire production there had been bought up by American interests. America and England were still open as sources of supply, but the distance and the high freight rates made purchases there impracticable. We did buy some crude rubber in England, but not in sufficient quantities to keep all factories going, and before the end of the year quite a number of our small rubber manufacturing concerns were obliged to close their plants. The larger factories were able to hold out until February and March of the present year, when many of these were obliged to shut down because no crude rubber was available.

In former years we purchased much Borneo and British Indian wild rubber through the Singapore market, chiefly because our manufacturers were under the impression that wild rubber was better than the plantation product, but also because the former was cheaper. We now recognize that in the end plantation rubber is cheaper than the wild varieties because there is no loss in washing and refining, as there is with Borneo and British Indian rubber which come to us in a very impure state. Of course, the prices for plantation rubber are not as high as formerly, but the same applies to wild rubber and to South American and African grades. We have a good opinion here of African rubbers, but most of our manufacturers are not equipped to handle them advantageously. The following table shows the prices we paid for the

most popular grades of crude rubber at different times during the year 1914 :—

	January and February.	July	August and September.	November and December.
Borneo rubber per 100 lb.	$ 52·50	...	...	$ 67·50
British Indian rubber	70·00	...	...	67·50
Plantation sheet	62·50	$ 57·50	$ 56·00	67·50
Fine Para hard cure	75·00	...	...	105·00

Pale crepe is the plantation type most used here, followed by smoke crepe and scrap, in order of importance.

During the past year the following rubber factories were our principal consumers of crude rubber: The Yokohama Electric Wire Works, Limited, Yokohama; the Mitatsuchi Rubber Manufacturing Co., Tokio; The Toyo Rubber Co., Limited, Tokio; The Nipon Rubber Co., Limited, Tokio; The Fujikura Electric Wire & Rubber Co., Limited, Tokio; The Nipon Wire & Cable Co., Limited, Tokio; The Kakuichi Rubber Co., Osaka; The Osaka Branch of the Yokohama Electric Wire Works, Limited, Osaka; The Sumitomo Rubber Works, Osaka; The Hirana Rubber Works, Osaka; The Mutsuda Rubber Works, Osaka; The Asai Rubber Works, Osaka; The Shimada Rubber Works, Osaka; The Asuma Leather Co., Osaka; The Bando Belt Co., Osaka; The Dunlop Rubber Co., (Far East), Limited, Kobe; The Naigai Rubber Co., Limited, Kobe ; The Kawaji Rubber Co., Kobe; The Settsu Rubber Co., Limited, Nishinomiya and Hyogo; The Kamenofuchi Rubber Co., Fakae and Hyogo ; The Kyushu Electric Wire Co., Limited, Fukuoka, and the Chugoku Rubber Works, Hiroshima. Of the total of our imports of crude rubber two-thirds were consumed in Osaka, Kobe and other western parts of Japan and the rest in Tokio and Yokohama.

During 1914 a new application for rubber was discovered here, and now rubber solution is being used for coating the thongs of the wooden clogs which almost all Japanese wear when out of doors. The widespread use of wooden clogs and this application of rubber to them is bound to increase our consumption of crude rubber.

The Japanese Imperial Steel Works at Wakamatsu, Japan, have placed a contract with a British firm for the installation of a benzol plant with an annual output of 2,400 tons of benzol.

JAPANESE EXPORTS OF RUBBER GOODS.

The most important items of our exports of manufactured rubber goods are rubber insulated electric wires and jinriksha and bicycle tyres, which we ship in quantities to China, Kwangtung Province, Hong-Kong, British India, the Straits Settlements, Dutch India, Great Britain and other countries. From the statistics I gave in my April contribution you will note that our exports in these articles increased more than 50 per cent. in 1914 as compared with the preceding year. The increase in these exports started in August, which goes to show that they were largely due to the stoppage of European shipments in these lines. By December the orders in hand were far in excess of our capacity to deliver; our output, as before said, being curtailed by the crude rubber embargo of our allies. Prices, however, were good and our manufacturers made substantial profits.

The following table shows weights and values of our exports of rubber goods through the leading ports of this country for 1914 :

From		Pounds.		Value.
Kobe	...	872,594	...	$536,970
Yokohama	...	6,930	...	4,214
Other ports	...	3,262	...	1,951
Total	...	882,786		$543,135

As will be noted, most of these exports were made through the port of Kobe. The following table shows the destinations of exports of rubber goods through this port for 1914 :—

From		Pounds		Value
China ...	...	341,244	...	$199,823
Kwangtung Province	...	2,305	...	1,139
Hong-Kong ...	...	2,913	...	1,345
British India...	...	37,689	...	30,644
Straits Settlements	...	221,572	...	141,041
Netherlands India	...	250,223	...	158,327
Great Britain	...	5,758	...	3,805
Other countries	...	10,890	...	846
Total	...	872,594		$536,970

RUBBER PLANTATIONS.

Rubber plantations here promise well for the future. We now have some 88,000 acres under *Hevea*, which will produce about 5,000 tons of rubber per year when in full yield. Our present consumption of crude rubber amounts to about 2,000 tons per annum.—INDIA RUBBER WORLD.

THE RUBBER INDUSTRY OF THE AMAZON.*

To those whose study of rubber questions is catholic in nature, the book under review is of considerable interest, especially in comparing the labour question in South America with the widely different conditions obtaining in the East.

A foreword by the RT. HON. VISCOUNT BRYCE serves as a key to the subject matter which follows and is especially worthy of study. VISCOUNT BRYCE declines to discuss the Monroe Doctrine, but it is made evident that the future treatment of the Doctrine will have considerable influence on the Amazonian rubber industry.

The book itself is founded on notes compiled by MR. J. F. WOODROFFE, edited and annotated by MR. H. HAMEL SMITH, Editor of TROPICAL LIFE. In addition to many chapters dealing with aspects of the labour question, there are others devoted to descriptions of Brazilian methods of preparation and cultivation of rubber, as well as some dealing with costs of production, the Monroe Doctrine, etc.

* THE RUBBER INDUSTRY OF THE AMAZON, by J. F. WOODROFFE and H. HAMEL SMITH. —TROPICAL LIFE Publishing Dept., P. 435.

We briefly describe below some of the views expressed, which will probably interest many readers of this journal. To those who desire a detailed description of Brazilian conditions we recommend a perusal of the work in question.

We gather in the first place that health conditions form the basis of the whole question, the social conditions of the workers and the methods of preparation and cultivation of the rubber forming the superstructure. "Damp air and lands, bad and insufficient food, these are at the bottom of all Brazil's trouble."

In this connection it must be remarked that the smoking of the latex appears, under present conditions, to have a serious effect on the health of the operator. "The hours of a good seringuero generally speaking commence before dawn and continue until 3 p.m., that period being divided between the collection and preparation of the latex.

"At the end of the day . . . . . the seringuero . . . . . will be found, after he has finished smoking his day's collection of latex, with tired sore eyes sunken and smarting from the effects of the smoke, his body racked with spasmodic coughing and covered with smoke, dirt and soot. From this work and from the long periods spent among the swampy jungle, the seringuero soon becomes distinguishable from other classes of labourers owing to the extreme pallor of his face and the yellowness of the remainder of his jaundiced body."

The middleman system appears to exist to an extent hard to realise. Mr. Woodroffe remarks that many concerns depend almost entirely upon profits from the sale of their goods to the seringueros and other labourers they employ to cover their living and general expenses whilst the profits from the rubber go to pay interests and, when prices permit, to reduce one or other of the mortgages that are always hanging over them. In another place it is remarked that the future of the Eastern industry rests to a large extent on co-operating with the west as to combined output of rubber. If the Eastern industry attempts to drive fine hard Para from the market the Amazonian rubber industry could be stopped temporarily and operations resumed again when desirable. This could not be done by Eastern estates, or at any rate by only a very few of them.

A considerable proportion of the book is devoted to a discussion of the labourer's food supply, the conclusion arrived at being that facilities should be given to small farmers and industrials in order that agricultural produce of various sorts may be raised on the spot.

Mr. Hamel Smith's views appear to incline to some scheme for the immigration of Japanese, Chinese, Siamese and others not only for the purpose of forming colonies of their own and of introducing new industries but also partly in the hope that they will interbreed with the mixed races of the Amazon and so instil into them some of their energy and enterprise.

That the backward Brazilians will continue to oppose Oriental immigration is, however, a matter of little doubt.

It is not proposed to discuss those chapters of the book dealing with Amazonian methods of cultivation as compared with plantation methods, as the general outlines of the subject will be familiar to most readers of this journal. The impression one gathers is that if the Brazilian industry is to be

placed on a sound footing, extensive alterations will have to be made in almost each of its branches, from the treatment and health of the collector to the economic system of disposal of the rubber. That in their opinion the task is not an easy one, is made abundantly clear by the authors—but their spirit is one of optimism.

L. E. CAMPBELL.

MANURIAL EXPERIMENTS WITH YOUNG RUBBER.

F. G. SPRING.

Descriptions of these experiments were published in the Agricultural Bulletin F.M.S., Vol. I, p. 194, Vol. II., p 88 and Vol. III., p. 9, and the results for the first, second and third year were given. Before considering the fourth year figures it would perhaps be as well, for convenience sake, to give a few particulars which have been published in the previous articles. The land on which the tests were made is not ideal for manurial experiments. It was necessary to divide the plots into two sections, namely, A and B, as there was not a sufficiently large area of one description of land to carry out the required number of experiments.

The nature of the soil is laterite and would appear to be below the average as regards soil fertility.

Plot A is fairly flat but plot B is sloping, a disadvantage in experiments of this nature, as there is a tendency for manures to be washed from one plot to another.

The land was weeded once in six weeks, the control plots being weeded as often and treated in a similar way to the manured as regards cultivation.

In the first application the manures were forked lightly in around the young trees to a depth of 2 to 3 inches, between two circles of 1 and 4 feet radius, the tree being the centre of the circle. At the time of the second application the trees were two years older, in view of which the fertilizers were spread broadcast all over the soil and lightly forked under.

Quicklime was used in each case, the lumps being distributed throughout the fields and allowed to slake naturally. The lumps soon became reduced to a fine powder and it was found easy to distribute. One night's rain is sufficient for this decomposition to take place, but in dry weather it may take several days.

Full particulars as to quantities of manures and dates of application, girth, and number of trees, etc., are given in the tables.

In reviewing the results of the four years it is noticeable that during the first year, the trees in the manured plots, in every case, showed a good excess in girth measurements over the trees in the unmanured plots. In the second year, there was no manure applied, and reference to the tables will show that the average girth increases, for this period, are about equal to that

of the control plots which goes to prove that the manures had good effect for one year only. At the commencement of the third year, a second application of similar manures was applied, and the results for this year show that in one block of land the trees in the manured plots have, in each case, an excess in girth measurement over trees of the unmanured plot but not as large an excess as was evident the first year. In the other block of land there is no appreciable difference, in the third year, between the average girth increases of the manured plots and control. As the quantities of manures in both applications were equal it would be expected that better results would be obtained with the first application as the manures were more concentrated in the root feeding area.

In the fourth year no fertilizers were applied, and it will be seen that the manured plots have not given as large an average girth increase as the control plots; in fact there is a distinct falling-off in girth increase as compared with them for this year.

In this particular soil, the fertilizers appear to have had a stimulating effect, as regards growth, after each application for about one year, but afterwards there seems to be a slight reaction.

Although over the period of four years the total increases in the manured plots in every case exceed that of the controls, as shown in the tables, it would be impossible to say to what extent the fertilizers have been profitable, this can only be shown by yields of latex. The trees are shortly to be tapped and in future results will be based on yields of rubber.

In previous reports, on this experiment, the number of trees stated is 120, but owing to a quantity having to be cut out, through various reasons, the number in each plot was reduced to 100 at the commencement of the fourth year, but as the results are based on average girth increase this does not affect the experiment.

TABLE A.

Plot.	Fertilizer added.	Total increase over a period of 4 years.	Excess over control plot for a period of 4 years.
1.	Sulphate of Ammonia Double Superphosphate, Lime ...	23·21 inches	2·47 inches
2.	Sulphate of Ammonia, Lime ...	23·69 ,,	2·95 ,,
3.	Sulphate of Ammonia, Double Super. Sulphate of Potash, Lime ...	24·28 ,,	3·54 ,,
4.	Sulphate of Ammonia Sulphate of Potash, Lime ...	21·55 ,,	0·81 ,,
5.	Double Superphosphate, Sulphate of Potash, Lime ..	22·11 ,,	1·37 ,,
6.	No manure ...	20·74 ,,	

TABLE B.

Plot.	Fertilizer added.	Total increase over a period of 4 years.	Excess over control plot for a period of 4 years.
7.	Sulphate of Potash, Lime ...	22·52 inches.	1·38 inches.
8.	Double Superphosphate, Lime ...	22·68 ,,	1·54 ,,
9.	Lime	22·22 ,,	1·08 ,,
10.	Perlis Guano	22·67 ,,	1·53 ,,
11.	Bone meal	23·19 ,,	2·05 ,,
12.	Sulphate of Ammonia, Double Superphosphate, Sulphate of Potash ...	22·80 ,,	1·66 ,,
13.	No Manure	21·14 ,,	

No. of Plots.	Fertilizer added.	Excess increase in girth over trees of the unmanured plots. 1st year	2nd year	3rd year	4th year
2.	Lime, Nitrogen ...	1·36 in.	0·19 in	0·98 in.	0·42 in.
4.	Lime, Nitrogen, Potash ...	1·23 ,,	0·04 ,,	0·54 ,,	-1·00 ,,
1.	Lime, Nitrogen, Phosphate.	1·87 ,,	0·28 ,,	1·66 ,,	-1·34 ,,
5.	Lime, Potash, Phosphate...	1·87 ,,	0·51 ,,	0·83 ,,	-1·84 ,,
3.	Lime, Potash, Phosphate, Nitrogen	2·35 ,,	-0·01 ,,	1·53 ,,	-0·33 ,,
9.	Lime	1·05 ,,	-0·58 ,,	0·30 ,,	0·31 ,,
7.	Lime, Potash... ..	1·12 ,,	0·24 ,,	0·20 ,,	-0·18 ,,
8.	Lime, Phosphate ...	1·87 ,,	0·26 ,,	-0·16 ,,	-0·43 ,,
12.	Phosphate, Potash, Nitrogen	1·48 ,,	0·15 ,,	-0·30 ,,	0·33 ,,
		Manured	No manure applied.	Manured	No manure applied.

—F. M. S. BULLETIN.

The Hawaii Experiment Station is making attempts to secure a strain of *papaya* with self-fertilising flowers, thus doing away with the necessity for male trees. The results hitherto obtained are most promising, and complete success in two or three generations is promised. Of the second generation of breeding, 454 trees examined showed 95⅓ per cent. with perfect flowers for fruit-bearing. One most interesting experiment was that of cutting down two male trees two feet from the ground. When the new branches came out it was found that the sex had changed, and that regular, perfect flowers, each bearing fruit, were developed.:—WEST INDIA COMMITTEE CIRCULAR.

RICE.

THE RICE CASE-WORM.

In certain years, during the months of August, September, and October when paddy has grown over a foot in height, a serious pest appears in many parts of the State called Kokre Roga. The popular name describes the usual symptom of the leaves showing white patches here and there and of their tips turning white altogether. This injury results from the work of caterpillars which scrape off the green substance in patches and leave the skeleton bare or cut the leaves, so that the tips fade and dry away. The appearance of a field so affected cannot be mistaken as the whole crop appears whitish and shrivelled up. The attack is often localized as but a few acres are affected here and there.

The caterpillar that causes the damage is easily recognised by the peculiar habit it has of cutting off bits of the blade and using these as a case for its body. The edges of the bit will be webbed together and three-quarters of the body will be hidden inside only just enough of the head and body appearing to enable the caterpillar to feed and crawl without hindrance. The full-grown caterpillar will be nearly three-fourths of an inch long, of light green colour with an orange head. When one is gently taken out of its case and placed in a little clear water, say, in the palm of the hand and observed closely, delicate white hairs can be seen proceeding from the caterpillar and floating all round. These are delicate tubes which enable the caterpillar to breathe in water.

As many as a dozen caterpillars may be found on a single plant hanging from the leaves and feeding. Numbers will be swimming in the water below, with the cases on. These caterpillars when full grown withdraw into the case completely and then turn into a pupa, a yellowish brown seedlike thing restive, when removed from the case. From these pupæ, small pretty moths emerge with whitish wings having yellow bands across. These moths are male and female. They pair and the females lay eggs singly on the plants, from which the caterpillars again hatch out. This is the life cycle, eggs, caterpillars, pupæ, moths, and there are usually several such cycles, each succeeding cycle more numerous than the one previous. It is therefore best that the appearance of the first brood is detected and remedies tried to prevent the succeeding generations.

A simple remedy is available which by careful manipulation can effectively deal with the pest. It has already been said that the caterpillars are adapted for breathing in water. There is another curious habit which is of importance, that even those feeding on the plant drop to the water immediately on disturbance. If therefore a little kerosene can be spread in a very thin layer on the surface of the water and the caterpillars are all made to drop by disturbing them, the kerosene will soak through the long hairs into the body and the caterpillars will be killed, for kerosene is deadly to insects of all kinds. To spread the kerosene a rag soaked in it may be kept where

the water is let into the field. As the water flows in, kerosene will be taken gradually until the whole plot has an even spread of it. Disturb the caterpillars on the plants on to the water and in about a couple of hours the caterpillars in swimming about will have been covered by a layer of kerosene sufficient to kill them. And the quantity of kerosene required is very small, just enough to produce a very thin film and no more. Of course, during the whole time the water should not be allowed to flow out of the field. When the caterpillars are seen to be dead, the water may be let into the field next below and a little more kerosene may be added if necessary. It is best that all the owners of affected fields co-operate, for then the operation can be started from fields of the higher level and continued to those below, the cost of kerosene required will be much less as the same kerosene used in one field can be used in others below and the treatment of the whole area will practically rid the locality of the pest for the season. Whether the owners co-operate or not in regard to the purchase and use of kerosene, they must do the work about the same time for satisfactory results.—Mysore Agricultural Calendar, 1916.

MAIZE AND SUGAR-CANE.

In maize, the stalk is a column composed of successive "joints" (the nodes and internodes), which, in their intergrowth, are permanently fused together, so that when combined they constitute a single individual. In sugar-cane the joints, when mature, have no vital connection with each other, and each may be regarded as a separate individual. In cane, the reserve sugar is distributed quite uniformly through the pith cells or parenchyma of the internodes, but little of it is found in the nodes. It maturing, the joints ripen successively from the foot of the stalk upward. In maize, on the contrary, the sugar is stored in the greatest abundance within and directly above and below the node, and at that time there is a constant interchange and distribution of this material as it is formed throughout the whole length of the stalk, the upper joints—except the last two—maturing at the same time as the lower. Equally important with the sugar is the pulp and cellulose product, consisting of the substance of the whole stalk in a highly purified condition after the sugar has been extracted, the whole of it ready to be reduced at once into the finest quality of pulp and cellulose. On account of the absence, in this case, of the hard silicious coating which covers the cornstalk when the grain has ripened, and which prevents the best of the fibrous matter, which it contains, from being utilised, the pulp obtained is doubled in quantity and is of a much superior quality. A necessary incident to the sugar process is the removal of the immature ears and husks from the stalk. This field stuff amounts to about 80 per cent. of the weight of the stalk, and adds a third class of products obtained from the same plant, utilised principally in the manufacture of food products and alcohol.—Auckland Weekly News.

FRUIT.

SMOKING MANGO TREES.

In connection with an enquiry made by this Department at Kew concerning the practice of "smoking" pine-apples in the Azores, which has been found to hasten the time of flowering of that plant (see Agricultural News Vol. XIII., No. 320, p. 245), the Assistant Director of Kew (Mr. A. W. Hill, M.A., F.L.S.,) has forwarded to this office a copy of an interesting account appearing in No. 104 of the publications of the United States Office of foreign seed and plant importation, on the subject of the effect of smoke on the mango.

Mr. Henry H. Boyle on his late visit to America was requested to write a full account of a very interesting practice of the Filipinos which they believe ensures a good crop of mangoes. In his letter of March 6th, 1915, he gives the following description of "The smoking of mangoes:" A fire is built under the tree, then a bamboo shield is placed so that the smoke from the fire is directed upward through the branches of the tree. In some cases a smoke stack is made out of bamboo and placed under the tree. The fire is built under the hood. This is by far the most effective method of having the smoke spread through the branches of the tree. The natives of Cavite Province start to smoke the mango trees the first part of August and continue until the flowers have been pollinated and the fruit set. The time consumed in smoking is about one month. Weeds, leaves and rubbish are used for fuel. Care should be taken not to let the materials blaze. This can be prevented by placing rice chaff, banana leaves or sawdust upon the pile to be burned. The object of the smoking is, according to the natives, to cause the tree to produce flowers earlier and to have the fruit ripen earlier. It also helps to dry the flowers which have become wet from the dew and materially helps to keep down the harmful insects and fungus. The smoking is stopped when the fruit is the size of a marble. Nicking is performed when the tree reaches the age of six or seven years. The time selected is about the first part of November, which is the dry period in the province of Cavite. The tree is first nicked from the ground upward as far on the trunk as it is possible to reach, or to the first branch. Care should be taken not to injure the cambium layer to too great an extent. The smoking is performed upon trees that have not been *nicked* or *taga* as they say in Tagalog. The nicked or slashed trees after smoking will produce fruits three months earlier than those that have not been nicked or smoked. This nicking is done by a sharp bolo. When I first saw the nicking and smoking stunt used on mango trees, I was of the opinion that it was more injurious than beneficial, but now after three years of observation I can readily see that it is a wonderful help to trees raised from seeds. They fruit and fruit earlier than those not treated in the manner described, and I have never seen any bad results caused by the nicking or smoking. This is saying a good deal, as I have seen mango trees in every island of the Philippines treated in the manner described. There is another matter,

regarding mangoes, which I spoke to you about when last in Washington: namely the method employed by the natives for keeping mangoes six months. It is as follows: A kerosene tin which holds five gallons is used as the receptacle. An equal amount of second grade molasses and sawdust is mixed or as much molasses as the sawdust will absorb is used. The quantity of the above material used depends upon the amount of mangoes placed in the tin. It is however, necessary, to have the mangoes completely immersed. The tin is then made air tight by soldering. The second grade molasses is cheap here, due to the large number of sugar mills, so the expense thus incurred is very little. I have arranged to have one tin of the first mangoes packed in this manner sent to you so that you may see if the method is O.K.—Agricultural News.

GRAFTING MANGO INFLORESCENCE.

W. S. BURNS AND S. H. PRAYAG.

The inflorescence of the mango (*Mangifera indica* L.) often becomes wholly or partly vegetative. One side of the branch may be reproductive while the other is vegetative. These differences in function and external morphology are found to be correlated with the internal structure, the vascular tissue being thicker and better developed on the vegetative side of the axis.

The writers have shown that the inflorescence may be grafted either on to another inflorescence or on to a vegetative branch. As a rule the inflorescence thus grafted dies after the fruit is ripe, but may persist and put out vegetative axillary branches.—Bull. Int. Inst. of Agric.

CITRUS CULTIVATION.

The following summary of details that should receive attention in cultivating limes apply equally to all citrus fruits. They are based on a leaflet issued by the Agricultural Department of St. Lucia:—

Provide wind belts; don't plant too deep; keep the trees a reasonable distance apart; plant up only as much as can be properly looked after; keep off suckers; till the soil well if quick returns are to be looked for; heavy soils should be forked, but do not fork when the trees are in fruit; drain thoroughly; manure liberally if you want good crops.

A new industry, mango preserving, has recently been started in Manila, and promises to develop considerable proportions. According to the Journal of the Royal Society of Arts, for years efforts have been made in the Philippines in this direction. The flavour of the mango is extremely delicate, and difficult to preserve, but a satisfactory process of putting up the fruit in glass jars has been discovered. The preserved fruit is known as mango honey.—West India Committee Circular.

SUGAR-CANE.

SOME CONSIDERATIONS ON BUILDING UP A STAPLE SUGAR INDUSTRY IN CEYLON.

Past experience on sugar production and the distressful state of affairs, at present, of the sugar industry in the Southern Province has prejudiced the minds of very many on the prospects of organising a sugar industry in Ceylon.

Characteristic of all these past attempts has been the tendency to grow sugar-cane on the same system as we grow our estate products, e.g., coconuts, rubber, etc.—a system which at its best can be described as one of refined forestry. Here, a district where a heavy and constant rainfall is assured is first selected; planting is done on an extensive scale with little or no preparatory and after tillage. Except in the preparation of the crop for market there is nothing to compare between sugar production and that of our estate industries.

Sugar-cane is not a crop that you can leave to take care of itself. With the possible exception of tobacco there is not another staple agricultural product where the physical condition of the soil plays so important a part as it does in the growing of sugar-cane. Compared with its great size the sugar-cane has a root-system which is quite restricted and shallow. To facilitate in every way the full exercise of the roots' functions we must see that the soil is in good mechanical condition. Hence the cane demands intensive cultivation, meaning by this the concentration of capital as well as labour on limited areas of land.

In growing cane under conditions of steady rain and, consequently, weak sunshine, especially on soil poor in lime and potash we may get cane of phenomenal growth but it becomes gorged with unassimilated salts which together with the development of gummy and other organic matter depreciate the value of the cane.

The cane produced has a low sugar-content and a high glucose ratio, consequently the comparatively small amount of sugar turned out is of low polariscope test, is soft and of very inferior quality.

Then again, in our districts of heavy and constant rainfall, wherever the annual precipitation is above 75 in., such products like rubber and coconuts yield large profits. They appeal to the temperament of the people, the labour needed is far less whilst they admit of extensive cultivation.

It is to our irrigable tracts that we must look for any possibility of building up a staple sugar industry. Here the country is still undeveloped, there are no agricultural industries to compete with it and land is available in large blocks. In the North-Central Province alone there are nearly 40,000 acres of irrigable land available. In the Mannar District in close proximity to the railroad there are 20,000 acres irrigable under Giant's Tank.

The physical conditions of importance that have to be taken into consideration in these districts are the nature of the soil and irrigation facilities.

Strong sunshine, so very essential for the production of cane of very high quality, we are assured of in such areas.

The soil will demand some careful amount of examination, as very often a stiff clayey subsoil prevails in such areas under our tanks. However, most of the land has been declared to be suitable for coconut cultivation, and as this palm cannot thrive where there is a stiff clay subsoil, one, doubtless, can with care select large blocks amongst those areas recommended for coconut cultivation. Sugar-cane needs a moderately fine soil with free æration. "A permeable subsoil that will admit of free drainage without excessive leaching" is the best.

We next consider our irrigation facilities. It has been very expressively stated that "The whole *rationale* of sugar-cane growing involves that it be forced and forced constantly from the day the cane first sprouts till it is ready to lay by and ripen." This suggests how a check of any kind is fatal and how very necessary it is that an adequate supply of food and water is always available. Once there is a cessation in the functions of growth, be it only for a few days, it means that starch and fibre becomes elaborated at the expense of the sugar present in the cane, for sugar, it must be remembered, is but a temporary storage product, and about the first product elaborated by the plant from the simpler food products derived from the air and soil. The final and more permanent product is starch with its elaboration into fibrous and woody tissues.

Drainage is of importance because water-logging however slight interferes with the functions of growth and nutrition.

It will thus be seen how important it is that the sugar-cane planter is guaranteed an unrestricted supply of water available at any time that he wants it so that he may not only irrigate his crop during the periods of drought but as well enable him to tide over any trying breaks during monsoonish weather, which, especially in such districts, is so variable and inconstant.

Sugar cane will not need such heavy waterings as paddy does, but water must be available all throughout the year in amounts broadly stated as not exceeding three inches at any one irrigation. If we include any rainfall amounting to one inch and over experienced in such tracts, sugar cane will not need more than 20 irrigations throughout the year.

The Irrigation Department only can finally decide whether such an unrestricted supply of water can be assured to the sugar-cane planters; whilst the would-be sugar-cane planter should, unless he would court failure, make himself thoroughly acquainted with the irrigation facilities available in any such district before deciding to go in for sugar-cane growing.

Having decided on a tract that is in a position physically to grow cane successfully, we have next to consider the question of handling the outturn and preparing it for market. Here we get out of the limits of agriculture proper and find ourselves involved in economic questions of great complexity.

It may be taken for granted that to compete successfully in the market sugar must be manufactured on a factory basis by means of modern machinery.

The cost of manufacture should not, in Ceylon, go above Rs. 60 per ton of sugar. In the West Indies* and Trinidad the cost of manufacture fluctuates between Rs. 50 and Rs. 55 per ton of sugar. In Australia the average cost of manufacture has been worked out to be about Rs. 65 per ton of sugar. This, with the high rate of wages for labour which is about Rs. 3 per day of 8 hours besides rations.

In Ceylon we have, with the possible exception of India, the cheapest rate of wages and Rs. 60 forms quite a liberal estimate. The net cost of manufacture can be still further reduced if we estimate the prices realised on molasses. In a modern factory the quantity of final molasses to a ton of sugar amounts to $\frac{2}{5}$ to $\frac{1}{2}$ ton. This has been estimated at Rs. 20 as the lowest price and thus the net cost of manufacture comes to only Rs 40 per ton of sugar.

The economic size of a factory is one that can deal with 1,500 tons of cane per day of 22 hours. This is a size that is hardly practicable in Ceylon; a factory with a normal capacity of 500 tons of cane a day is best suited to our conditions.

If we estimate that such a factory has a working season of 100 days, then the acreage necessary is about 3,500 acres (estimating that an acre has such a low yield as 15 tons of cane). Such a factory has been stated to cost about Rs. 600,000.

Another consideration must be emphasised, in working such a big block as 3,500 acres, unless modern agricultural machinery like steam ploughs with disc harrows and other cultivators are used, the land cannot be worked as intensively as desired unless a large labour force is maintained. The latter will raise the cost of growing a ton of cane so high as to make the project a failure.

The cost of growing cane per ton remains at a remarkably constant figure in India despite various methods of cultivation. In absence of reliable figures for Ceylon we may estimate that this figure is somewhere about Rs. $6\frac{2}{3}$ per ton of cane. This means that the cost of cultivating an acre yielding so very low as 15 tons of cane is about Rs. 100. Taking the cane to be that of an average type, in a modern factory the same quantity can be turned out as $1\frac{1}{2}$ tons of sugar. Thus a Joint Stock Company working with an adequate capital with modern machinery both for cultivation and manufacture ought at a very liberal estimate be able to grow and turn out one ton of sugar at a cost of little more than Rs. 100 per ton of sugar.

HENRY L. VAN BUUREN, JR.

The Agricultural Chemist, Queensland Department of Agriculture, has made the following analysis of crude banana ash :—

Potash	...	...	16·6
Lime	...	...	5·0
Phosphoric acid		...	1·4
Insoluble, chiefly carbon		...	34·7

* My authority for this and other subsequent figures is G. N. Sahasrabudhe, Sugar Expert, who as State Technical Scholar studied modern methods of sugar manufacture for two years in the West Indies. For further details and his report cf., Bombay Bulletin No. 60 of 1914. Dept. of Agriculture.

TOBACCO.

TOBACCO-WILTING, CURING, FERMENTATION, CHEMICAL CHANGES, ETC.

[*Paper read before the Board of Agriculture, Jaffna.*]

WILTING.

The wilting of tobacco which takes place immediately after harvesting is due to evaporation and is not strictly a part of the curing process. Although thorough wilting hastens the curing practically no chemical change is produced in the leaf. In fact, plants often become wilted during the heat of the day in the growing season.

CURING.

Tobacco curing, in the broad sense of the term, implies all the changes which take place in the curing shed, fermenting house or ageing room. The term, as it is ordinarily used by tobacco growers, refers only to the change which occurs in the curing shed.

Certain requirements must be met in order properly to cure tobacco by any method. The leaf must be sufficiently ripe and in sound condition. Any portion of a leaf that has been killed by excessive evaporation, bruised, sunburned, or subjected to poisonous gas, can never be properly cured. It is therefore a life process, and the plant must be kept under suitable conditions as regards heat and moisture, to prolong life as the curing proceeds. At a temperature as low as 60° Fahrenheit, curing practically ceases, though evaporation may continue, if the curing shed is too open, during dry or windy weather. At a temperature of 130° Fahrenheit, the plant life is killed. There is little danger of extreme temperature in Ceylon, but these facts should help us to understand that the curing is a life process, and amounts to more than the mere drying of the leaf, which could easily be done outside this range of temperature. It is also quite possible to cure the leaf without sufficient drying, in which case, pole sweat, stem rot or mould, are apt to develop. If tobacco is too closely crowded in a room, and the stems of the leaves become brittle, it is an indication that pole sweat is about to develop. The tobacco should immediately be more widely spaced in the barn, and more ventilation given. If, on the other hand, the tobacco is drying too rapidly, and becoming crusty and crisp, prior to browning, the curing shed should be more tightly closed. If necessary, the floor should be sprinkled with water or the tobacco crowded more closely. Tobacco loses from 12 to 30 per cent. of dry matter during curing. Tobacco cured on the stalk always loses more in weight, sometimes twice as much as it would lose when harvested by the single leaf method. This, though contrary to the general belief, is a proved fact.

The curing process is variously modified according to the use for which the leaf is intended, the difference in procedure pertaining chiefly to the rate of drying; this, in turn, is controlled mainly by the use of artificial heat. The

character of the cured product is greatly modified by these different methods, and it is necessary to consider separately those cured with, and those cured without, the aid of artificial heat. The most widely practised methods are air-curing, sun-curing, flue-curing and open fire-curing.

The curing may be divided into two periods: during the first the leaf remains alive, while in the second, the changes which occur have no connection with its life activities.

Practically all the cigar tobaccos and the immense quantities of White Burley tobacco are cured without the use of artificial heat, or by what is known as

AIR CURING.

After harvesting, the tobacco is hung up in an enclosed roomy shed where the leaf undergoes a slow process of *starvation*, unless it is killed by bruising, heat, or by too rapid drying. Of course, the leaf must have food in order to remain alive, and this comes from the reserve supply which has been stored up. The ripe leaf is very rich in starch, and one of the important changes in the curing is the disappearance of most of this starch, which is consumed by the living portion of the leaf itself. If the leaf is prematurely killed there is no means of removing this starch, and the tobacco is harsh, lifeless, and strawy. After the starch is nearly all used up, it is probable that some of the nitrogenous constituents are attacked as a last means of prolonging the life of the residual living matter.

Along with these changes in composition, the green color is replaced by a lemon yellow. This is a characteristic of all tobaccos, whatever the curing method may be, if properly conducted. The green coloring matter, called chlorophyll, is peculiar to all plants, in very similar, but not identical forms. During the period in which the leaf tissue undergoes starvation, this green coloring matter is more or less completely changed into colorless substances and the appearance of the yellow color marks the approaching death of the leaf, the yellow color indicating the end of the first period of curing.

In the second, the changes which take place are not dependent on life process, and are quite different from those occurring in the first stage. They consist mainly in the further breaking up of the products formed in the first stage. One of the most important changes is the brown color, formed by a process of oxidation, which takes place after the cells are dead. As soon therefore, as portions of the leaf die, they at once begin to turn brown, provided sufficient moisture is present. The two essentials for the development of the brown color are a supply of oxygen from the air, and sufficient moisture. If the drying has proceeded too slowly and excessive moisture is still present, development of the brown color will proceed too far causing the leaf to cure dark.

The most favourable temperatures for air curing are between 70 and 100 degrees Fahrenheit, and the relative humidity should be about 85 per cent. Under these conditions moisture will gradually lessen and the curing will proceed smoothly.

SUN CURING

is used in few localities as a modification of the air process employed for curing certain types of plug or chewing tobacco, by being hung on scaffolds and exposed to the sun for several days. It is then transferred to the curing shed and finished off by the regular air method. This method has not been investigated.

FLUE CURING.

The distinctive feature of the flue method is that the curing shed is constructed as nearly airtight as possible, and provided with a system of large pipes or flues, diffusing heat which is completed within a few days, the object being to prevent smoke from coming in contact with the tobacco.

Heat is applied immediately after the tobacco is hung in the barn and rapidly increased to about 100 degrees Fahrenheit. At this temperature the tobacco yellows very rapidly, provided sufficient humidity is maintained. As green tobacco contains about 75 per cent. of water, which is constantly being given off, it is easy to keep the air moist under this temperature, if the barn is sufficiently tight. When the tobacco is almost completely yellowed, the temperature is rapidly increased, finally reaching 175 or 180 degrees when the curing is completed. At the same time ventilation is provided, in order to bring about a rapid drying which will kill the leaf and fix the yellow colour. If not done at this stage the leaf would turn brown, and resemble in colour, tobacco cured by the other methods. The killing of the leaf in this process before the yellowing is completed, fixes some of the carbohydrates in the leaf, and when the high temperatures are reached these give a sweet smell and flavor.

One of the principal factors is the bright lemon yellow colour, and the two prime conditions are the right kind of soil and proper control.

FIRE CURING

is universally adopted in heavy export or shipping tobaccos. The tobacco is hung in a moderately tight curing shed and allowed to begin yellowing before applying heat. Slow wood fires are started on the floor beneath and gradually increased in intensity as the curing proceeds. The entire process takes from one to two weeks and cures a dark brown leaf.

The tobacco is exposed to the smoke from the open fires and consequently it acquires a characteristic flavor and odour. The creosotic substances absorbed from the smoke possess antiseptic properties and prevent injury to the leaf in shipment to foreign countries.

FERMENTATION.

In the general understanding of the term, only cigar tobaccos are fermented. The fermentation is of great importance and the curing process must be conducted with the idea of developing oxidizing enzymes, upon which largely depends the success of the fermentation. In the curing of cigar leaf an attempt should be made to have the leaf become dry, and brought in case, once in twenty-four hours, when the curing is nearly completed. More of the oxidizing enzymes are formed in the ribs of the leaf than in the tissues, and the alternate drying and moistening of the leaf brings about a movement of the contents of the ribs out into the leaf web. The longer the ribs and stem are permitted to live the greater will be the amount of enzymes formed.

Fermentation develops the aroma of the tobacco, depending mainly on quality of leaf and the skill of the operator to regulate that fermentation. 23 to 24 per cent. of moisture ensures proper fermentation; a higher per cent. causes liability to decay, and may result in failure. The proper condition is soon learned by experience and the pliability of the leaf to touch is the only test.

Several methods of fermentation are practised but fermentation in bulk is the most modern and widely practised. Rooms heated with steam and kept at a temperature of from 75 to 80 degrees Fahrenheit with humidity maintained at 80 to 90 per cent. and even as high at times as 100 per cent. are best. Different grades of tobacco should be bulked separately and given different treatment. For example, wrapper leaves of light shade must not be fermented so heavily as the filler leaf, as they will become too dark. Fermentation varies according to the presence of oxidizing enzymes.

From 3 to 5 thousand lb. of the light grades, 8 to 10 thousand lb. medium and 10 to 30 thousand lb. ordinary fillers, are the average bulks. The greater the fermentation desired the greater the per cent. of moisture allowed when bulked. The wrappers are therefore in a somewhat drier condition than the fillers. These bulks may be from four to five feet wide, from four to eight feet high, and of any length. The bulk should be made on a platform raised a few inches from the floor. The butts are placed toward the outside of the bulk, the tips toward the center. The first row is laid with butt ends even with the edge of the bulk, the second, butts resting on about one-third of the tip ends of the first, and so on with the third row. Three rows in from each side, or six rows in all, is as much as will ordinarily be required for each layer. A perforated tube is placed in the center, one end being left exposed at the side, into which a thermometer can be inserted. The temperature should be watched very carefully especially during the earlier stages of the fermentation. When the bulk is completed, it should be covered with canvas blankets, or rubber sheeting. No weights should be placed on the bulk, when the fermentation is being done in a properly constructed room; the idea being to leave sufficient space between the layers to permit the escape of undesirable gases which are formed during fermentation.

The temperature will begin to rise in a short time and continue to increase at the rate of from 5 to 15 degrees a day, depending on the percentage of moisture present, until the temperature reaches 130 degrees, when the bulk must be broken down and rebuilt. In rebuilding, the tops and sides of the old bulk should form the center of the new. Each bunch should be given a shake to free it from any of the objectionable products of fermentation, and to lessen the liability to rot and mould. The temperature of the tobacco will be lowered in handling to about the temperature of the room. The bulk will again heat up but not so rapidly, perhaps, as the first bulk. In 8 to 12 days the thermometer will indicate that the pile has reached a heat of 125 or 130 degrees, or that, perhaps, it has ceased to rise in temperature and remains stationary. In either case the bulk is to be rebuilt.

This process of bulking may have to be repeated several times, or until the best possible aroma is obtained. If the process be carried too far, the desirable products obtained in the earlier stages may be destroyed and the tobacco rendered unfit for smoking.

AGEING.

Ageing may be described as partly a process of slow fermentation and partly an oxidation of leaf contents without the agency of enzymes. It softens and mellows a tobacco, taking away its rawness and bitterness, as well as disagreeable odors, and improving both the aroma and burning qualities. All tobaccos require ageing, but cigar tobaccos, which have been through the intensified form of fermentation, require less ageing. Pipe, cigar, cigarette and chewing tobaccos are aged from 2 to 5 years before they develop their finest qualities.

WHY SOME TOBACCOS ARE NOT FERMENTED.

In the first place all types cannot be made to ferment properly, any more than certain good varieties of eating apples can be successfully cooked. Just as some people prefer at times eating apples to cooking apples, dried or tinned apples to cooking apples, so pipe, cigarette, cigar and chewing tobaccos are in demand, and are grown and cured to meet the various tastes of the consumers.

CHEMICAL CHANGES PRODUCED BY FERMENTATION.

During the fermentation of tobacco there is a loss of as high as 15 per cent. in weight, partly due to loss of moisture, and partly to loss of solid matter, through the decomposition of some of the products which are given off in the form of gases. The presence of ammonia is easily detected by the odor in the fermenting room. The starch changes to sugar, which in turn is usually destroyed in the fermentation.

The enzymes attack the protein contents of the plant cells which continue to be destroyed throughout the fermentation. With the decomposition of the protein contents, "Amino" compounds are formed. There is a loss of nitrate, a decrease in nicotine, and also a large decrease in tannin, the substance which imparts the bitter flavor to tobacco. There is a disappearance of a portion of the fat contents. If much fat or protein is left in the leaf, it will create products, when smoked, destructive of the finer aroma; one of the advantages of fermentation is that it does away with these compounds. There is also a decrease of the resin and gums, which seem to bear a close relation to the aroma. It is thought to be quite probable that these split up into other products that are aromatic. Citric, malic and oxalic acids are present in the cured leaf, and the citric and malic acids may be partly transformed to acetic and butyric acids. These acids certainly have something to do with the aroma; the presence of malic acid is supposed to render the leaves soft, pliable and elastic. Fermented tobacco is said to have "grain." This grain is a product of the oxidation in the fermentation and is due to the formation of crystals of calcium oxalate, and manufacturers consider it an evidence of good tobacco. It is certainly an evidence of thorough fermentation. During the fermentation there often appears an efflorescence on the leaf, called "saltpetre" or "light mould;" this is due to the presence of potassium, magnesia, sodium, calcium and nicotine salts, which may be present in excess and are forced to the surface during fermentation. They are supposed to injure the quality of tobacco, and are usually removed by spraying with a 4 per cent. solution of acetic acid.

A great many chemists are interested in discovering various changes which take place in tobacco during the curing and fermentation, and from time to time discoveries are made. It is thought that there are possibly a number of the changes which are not yet understood, and the result of future investigations will be awaited with interest.

B. F. SCHERFFIUS,
Govt. Tobacco Planter.

Jaffna, 29th February, 1916.

DESTRUCTION OF THE TOBACCO BEETLE.
(LASIODERMA SERRICORNE.)

D. B. MACKIE.

The object of these investigations has been to develop, if possible, an improved method for the treatment of cigars whereby all forms of the tobacco beetle may be killed. Realizing that the methods at present in practice do not meet with great favor for several reasons, though utilized by some manufacturers, a method of treating the finished product in a purely mechanical way, without disinfectant, is greatly desired. The effects of heat and cold having been studied and not being considered feasible, attention was given to vacuum in an endeavour to ascertain the effects of the same in controlling this pest.

For the purpose of experiments, a small metal chamber was constructed having a cubic content of $4\frac{1}{2}$ cubic feet fitted with a vacuometer, the pump being operated by a small electric motor developing one-fifth horse power.

Experiment No. 1.—Tobacco beetles in all stages were placed in test tubes which were placed in the vacuum chamber and the air exhausted to a point where the vacuometer registered $27\frac{1}{4}$". With the atmospheric pressure removed, the cellular tissue of the insects expanded, causing the insects to become greatly distended and causing a corresponding reduction in their vitality. However, despite the fact that the insects were held subject to these atmospheric conditions for periods up to and including three hours, many of them still showed signs of life and, upon normal atmospheric conditions being restored, immediately became active resulting in a negative experiment.

Experiment No. 2.—Insects were subjected to $27\frac{1}{4}$" vacuum, after which (CS_2) carbon bisulphide gas was introduced into the chamber and the vacuum reduced to about 16". Experiments resulted positively, all forms of the beetles being apparently killed.

Experiment No. 3.—This experiment was more or less a continuation of Experiment No. 2, the gas being in turn removed from the chamber by means of pumps and ordinary atmospheric conditions restored. As a result of this experiment, almost no trace of the gas was noticeable, there being no apparent odor. Cigars subjected to the treatment were smoked almost immediately upon completion of the treatment.

Experiment No. 4.—To determine whether or not the cigars are mechanically or chemically affected by the combination of the vacuum and gas. It

was found that for a long exposure, the gas in question tarnished all gold lettering such as is used in the bands and labels, though it has been ascertained that the time required to effectually destroy the insect life in the cigars is considerably less than that required to affect the coloring of the labels, etc.

When carried out in the manner set forth, this method offers certain advantages over those now in vogue, among them being the following which are listed in accordance with their importance :

1. Cigars and other tobacco products may be fumigated in case lots, the treatment in no way interfering or delaying the regular routine work of packing or handling the product.

2. It reduces the period necessary to kill the beetles by about 1/25 of that necessary under the old method.

3. It performs this function with much greater thoroughness than the old method.

4. It reduces the cost of fumigation to a minimum.

5. It enables manufacturers to treat practically an unlimited quantity of cigars daily.

6. The cigars being treated in their ultimate containers are not exposed to further infestation from the pest, thus obviating the necessity for especially constructed store-rooms.

7. It enables manufacturers to guarantee their products to be free from this pest.

8. The noxious gases generated during the treatment are entirely disposed of by the pumps, thereby lessening the dangers and inconvenience which sometimes result under the old method.

DISADVANTAGE.

It requires double fumigation to absolutely guarantee the product to be free from the pest in all forms.

GUNFIRE AND RAINFALL.

An impression has arisen in some quarters that the heavy and persistent rains recently experienced in this country [Great Britain] are attributable to abnormal atmospheric disturbances produced by heavy gun firing at the seat of war. The idea is by no means novel, and like other meteorological myths (such, for instance, as the belief in thunderbolts and the supposed influence of the moon upon our weather) it seems to possess a bullet-proof hide and takes any amount of killing. About four years ago the First Lord of the Admiralty was asked in the House of Commons whether he would instruct the Fleet to carry out their heavy gun practice at some period of the year other than in the middle of harvest time, 'when the resultant heavy rain may cause serious loss to the farming community.' A similar suggestion was made at the instance of a member of the Highland and Agricultural Society of Scotland who at a meeting of that body, moved that 'the Admiralty be petitioned to discontinue heavy gun-fire round the coasts in August and September, 'when clouds were about' *(sic)*, the speaker adding that 'firing was apt to bring down rain, and at that time of the year fine weather was desirable.' It may be said at once that the idea is absolutely without foundation. Experiments made some years ago in America and on the Continent showed that in droughty weather no amount of concussion in the air artificially produced had the slightest effect in the production of rain.

—THE TIMES (LONDON).

SOILS AND MANURES.

A. D. HALL, F.R.S.

In connection with the soil the big problem is probably the prevention of the waste that goes on at an increasing rate as the soil becomes more enriched by the accumulation of organic matter. Many soil bacteria, as we know, deal with the compounds of nitrogen in the soil so as to set free nitrogen gas from them, all of which actions are sheer waste of the most valuable constituent of the soil; and to such an extent does this change take place that we cannot as a rule expect to recover in the crop more than one-half of the nitrogen contained in farmyard manure applied to the soil. Where the soil is rich and high level of production is being arrived at, the percentage of waste may be even greater; for example, on the Rothamsted wheat plot which has received 14 tons of dung every year, only about one-quarter of the nitrogen applied in the manure has been recovered in the crop, and less than a quarter remains stored in the soil. When 100 lb., of nitrate of soda per acre is applied, nearly the whole of the nitrogen it contains will be covered in the increased crop; with an application of 200 lb. there may be a waste of 25 per cent. of the nitrogen, with still greater losses as the application is increased. The loss is not due to more washing out of soluble materials, because it is greatest when the nitrogen is applied in organic manures. Under existing conditions, high productivity in the soil is associated with a high rate of waste, and nowhere is this more marked than when cultivation is carried on under tropical conditions, so that one of the chief difficulties of tropical and semi-tropical agriculture is to maintain the stock of humus and nitrogen in the soil. An illustration of the waste that so often goes on in the soil is furnished in the practice of the cultivators under glass in England. For the growth of cucumbers and tomatoes they are in the habit of making up a very rich medium, half soil and half dung, but after a very few crops they are no longer able to use this mixture profitably, but must throw it away and renew their beds, though the rejected soil is still extremely rich in elements of plant food. The recent investigations at Rothamsted have shown that the fertility of this 'sick' soil can be restored by merely heating it for an hour or two to a temperature approaching that of boiling water, the cost of which operation is considerably less than that of renewing the soil. In this case the uselessness of the used soil appears to be due not to the destruction of the nitrogen compounds, but to their retention in a condition unavailable to the plant. The nitrogen compounds have to be broken down to ammonia or nitrates before they can feed the plant; this process is effected by certain groups of bacteria, the numbers of which are limited in the sick soil by the excessive development of another group of soil organisms—protozoa, amœbæ, etc., that feed upon the bacteria.

We are only just beginning to take stock of all the changes in the soil materials that are effected by living organisms, some necessary, some competitors with the plant, some wasteful; the ultimate problem is to bring these processes under control in the field as well as in the laboratory. The

antiseptic treatment of the land at large, after the fashion we now clean up soils in pots, may seem an impossible dream, but not more impossible than the production of a heavily yielding weedless field of wheat would have seemed to primitive man. Already much may be done to set up a better microflora and fauna in the soil by improving its physical conditions. The good effects of such processes as liming and drainage are largely due to the encouragement that thereby afforded to the valuable organism. Soil inoculation with such necessary bacteria as those which fix nitrogen when living in the nodules on the roots of leguminous plants has been widely attempted, but with very little practical success. The failures have generally been due to the fact that soils from which the nodule organism is absent are without it because of some chemical or physical defect; it is not sufficient merely to seed it with the organism, the soil itself must first of all be brought into a fit state to maintain its existence. The best of grass seeds would be wasted unless the land on which they are sown is first made clean and fertile. The amelioration of soils on their physical side, by bringing clay and silt to the sands, sand and coarse particles of various kinds to the clays, will eventually be taken up on a great scale, now that engineering has made it possible to move earth wholesale by cheaper means than by primitive spade and cart. I have seen a clod of clay carrying miserable pasture converted into a good market garden land by nothing more than the application of a thick layer of town refuse and ashes; only organization is needed to make such processes economic, even when the immediate, and not the ultimate, return is reckoned.

From the point of view of manures we shall have to look forward to an ultimate scarcity of nitrogenous fertilizers: the exhaustion of sodium nitrate is only a question of time; the present sources of sulphate of ammonia will disappear with the coal, and the water power which is now giving us nitrate of lime and cyanamide will then be too precious to be used in making fertilizers. Even if the new process for the synthesis of ammonia proved as economical as is expected, we ought still to depend upon the natural processes of nitrogen fixation, and make the farm self-supporting as regards nitrogen at a high level of production. The clover crop in the rotation usually followed in England will, under present conditions, gather in enough nitrogen for the growth of about 24 bushels of wheat to the acre, an equal quantity of barley, and 12 tons of turnips. How can we similarly maintain production at a level of 40 bushels of wheat, with other crops in proportion, yet without any nitrogenous fertilizer from outside?

A more immediate problem of the same kind is before the investigator; all around our great cities exist great market gardening industries, which have been built up by means of the cheap supplies of stable manure that were to be obtained therefrom. The market gardener close to London, and as far afield as Bedfordshire, rendered thin sands and gravels fertile by using 40 tons or more of London dung every year, but the advent of the motor car has curtailed, and will eventually put an end to, that supply, in which case how is the market gardening to be carried on? Nitrogen compounds and other bare elements of plant food can be bought, but humus is also necessary to get these thin soils to yield a proper growth; what needs to be worked out is the cheapest and most effective way of utilizing leguminous green crops and the other nitrogen-fixing organisms of the soil to maintain the fertility of such land, keeping in view the fact that it cannot be thrown out of productive cultivation for any

length of time. What is needed is not a field experiment merely, but a discussion of a whole system of cultivation on the economic as well as on the scientific side. This suggests the general consideration that economic research in agriculture is still in its infancy. How often do we find close at hand two farmers, both good practical men, with entirely divergent views on the rotation to follow or the management of their stock, one swearing by early maturity and a forcing diet, the other by cheap if slow production. The advantage of one system over the other is not a mere matter of opinion and personal idiosyncrasy; it is possible to reduce it to terms of pounds, shillings, and pence. The prime necessity is the application to farming of a system of costs book-keeping, such as prevails in a well-organized business. It is possible to obtain such figures from a farm; the method is as yet perhaps too complicated for the ordinary farmer to follow, but as an instrument of investigation in the hands of a teacher at one of the agricultural colleges it may be made to yield results of great value both to the individual farmer and to all those who have to take more general views of agriculture.

Returning to the purely scientific aspect of research, the whole of existence is based upon the fundamental process by which the green leaf utilizes the energy of the light falling upon it to split up the carbon dioxide of the atmosphere, and transform it into those fundamental carbon compounds—sugars, starches, etc., which build up the substance of the plant. The animal creates nothing; it is only a transformer, and rather a wasteful one at that, of the compounds initially built up by the plant. Now, though the leaf is thus the prime creative force, it is yet a comparatively ineffective machine for dealing with the energy contained in the light, for it does not succeed in storing up in the shape of plant materials it produces as much as one per cent. of energy that falls upon it as light, and in bright, tropical light the percentage utilized is even less. A steam engine given a certain amount of energy in the shape of coal, turns out again about one-seventh of it in the shape of useful work; a gas or oil engine is an even more effective transformer. Can the duty of the leaf be increased so that it shall effect a greater production of dry matter for the amount of light energy it receives? We know very little as yet about even the sequence of chemical changes in the leaf beyond the fact that we begin with carbon dioxide and water and end with oxygen and some sort of sugar; we are beginning to acquire knowledge as to the extent the rate of change is affected by the supply of light, carbon dioxide, and water, and by the temperature. But we have now many examples in chemistry of reactions being speeded up or rendered more complete by means of some adjustment of the external conditions, so it is perhaps not too much to expect that this fundamental process of carbon accumulations may also be tuned up until the leaf becomes of greater efficiency than at present in producing tissue from the materials and energy supplied to it.—(Extract from the Second Address Delivered by Mr. A. D. Hall, f.r.s., before the British Association.)

POTASH FROM PRICKLY PEAR.

In Queensland, the prickly pear is a troublesome weed, whose destruction on a large scale by means of arsenious trichloride has been proposed. It is possible to extract 15 per cent. of potash from the ashes of this plant by

washing. In this way half a ton of 80 per cent. potassium carbonate may be obtained from an acre. The ash is pricked up by a vacuum machine, but only half of it is removed.

This method is being worked on a block of 10,000 acres infested by prickly pear. It is possible that Queensland may eventually be able to export potash from this source.—BULL. INT. INST. OF AGRIC.

ASSIMILATION OF ATMOSPHERIC NITROGEN.

The most recent research on the subject, that of DR. E. MAMELI and PROF. G. POLLACCI, shows that not only the Leguminosæ, but many other flowering plants are able to make use of atmospheric nitrogen. Among flowering plants for which they claim this power are Cucurbita Pepo, Acer Negundo, Polygonum fagopyrum, and they also ascribe it to such "Water-Ferns" as Azolla caroliniana and Salvinia natans. FRANK long ago maintained the view that the power of assimilation of free nitrogen belongs to all green plants, and this view receives support from these recent researches.—THE GARDENERS' CHRONICLE, Dec. 4, '15.

THE USE OF LIME IN AMERICA.

One of the most remarkable things connected with American farming is the wonderful increase in the use of lime during the past few years. The practice of liming has spread wherever it was tried with the result that it became a general proposition. Practically every piece of land that has been under cultivation for 50 years requires a dressing of lime. When people began to understand this fact, there was a rush to learn about its different forms and methods. We now have a dozen forms of lime, each one adapted to particular conditions, and probably the greatest development of all has been in the preparation and use of ground limestone. We do not take up here a discussion of these different forms of lime and their special needs. On a very sour soil or on the heavier clays we should prefer a quicker lime than ground limestone, but without question the use of the latter has spread very rapidly over the limestone sections, and in order to supply the material properly, mills or crushers have been devised for preparing the lime stone. Some years ago this limestone crushing was largely confined to the localities where limestone was abundant. The lime was crushed and then hauled out to the farm. This was because it was thought that large and expensive machines were needed to do the crushing and these, of course, centralized the industry. Smaller and still powerful machines are now made. They are portable and can be hauled about from place to place, so that in any locality where a ledge of limestone can be exposed, these smaller mills can be made useful. It is remarkable how this business of crushing limestone with the smaller mill has developed. Hundreds of plants are at work throughout the country. In some cases they are operated on much the same principles as

thrashing machines or sawing outfits, as they travel from farm to farm crushing up a year's supply of limestone, just as the sawyer would cut up the year's fuel.—JAMAICA AGRIC. SOC. JOURNAL.

THE ATMOSPHERE OF THE SOIL.

E. J. RUSSELL & A. APPLEYARD.

This article, the first of a series, reports investigations of the composition and characteristics of the soil air.

It was found that the free air in the pores of the soil to a depth of 6 in. is very similar in composition to the atmospheric air, but differs in that it shows greater fluctuations in composition and contains more carbon dioxide and correspondingly less oxygen, the average in 100 volumes being 0·25 volume of carbon dioxide and 20·6 volumes of oxygen against 0·03 volume of carbon dioxide and 20·96 volumes of oxygen in atmospheric air. "Usually the sum of the Co_2 and oxygen is only slightly less than atmospheric air, but at periods when nitrates rapidly increase there is a perceptible falling off of oxygen and a still greater one in waterlogged soils."

In addition, there is another atmosphere dissolved in the water and colloids of soils which consists mainly of carbon dioxide and nitrogen and has practically no oxygen. "The fluctuations in composition of the free soil air are mainly due to fluctuations in the rate of biochemical change in the soil. . . . . The rate of biochemical activity attains a maximum value in the late spring and again in autumn, and minimum values in summer and winter. In autumn the bacteria increase first, then the Co_2 rises, and finally the nitrate increases. From November to May, ... the soil temperature. . . . . appears to be the dominating factor, from May to November. . . . . the rainfall and to a less extent the soil moisture. . . . .

"It is shown that the dissolved oxygen brought in (in rainfall) is probably a factor of considerable importance in renewing the dissolved soil atmosphere and facilitating biochemical change. . . . . No evidence could be obtained that the growing crop markedly increases the amount of Co_2 in the soil air, and if it gives rise to any great evolution of Co_2 in the soil, it apparently exercises a corresponding depressing effect in the activities of soil bacteria. . . . . As the soil differences are eliminated so the differences in composition of the soil air become less and less. . . . . Such weather conditions as barometric pressure, wind velocity, variations in temperature from the mean, small rainfall, etc., seem to have but little effect on the soil atmosphere."—EXPERIMENT STATION RECORD.

EFFECT OF MOISTURE CONTENT OF A SANDY SOIL ON ITS NITROGEN FIXING POWER.

C. B. LIPMAN & L. T. SHARP.

Studies of the natural nitrogen-fixing flora of a light sandy soil from a walnut grove with reference to moisture content are reported. The soil-culture method was used.

It was found that nitrogen fixation in this soil by means of its natural flora and under optimum temperature conditions takes place most actively with a water content varying from 20 to 24 per cent., based on the air-dry weight of soil. With 28 per cent. of moisture there was a slight decline in nitrogen fixation. With 32 per cent. a marked decrease in nitrogen-fixing power of the soil was evident, and a still greater decrease was noted with 36 per cent. Almost no nitrogen fixation, or very little, took place with a moisture content of 4 per cent. (air-dry basis), but a very marked increase occurred when 8 per cent. was present, and amounts of moisture equivalent to 12 per cent. (air-dry basis) gave about the same nitrogen fixation as 32 per cent. moisture.

It is concluded from these results that for the soil used the ærobic forms of nitrogen-fixing bacteria do best with a 20 per cent. moisture content. At higher percentages of moisture up to 24 per cent. the anærobic forms become much more active, while the ærobic forms are depressed in their nitrogen-fixing powers.—Experimental Station Record.

THE VALUE OF SOIL ANALYSIS.

Inquiries are frequently received by the Board from farmers and gardeners who wish to be informed where they can have soils analysed. In most cases the idea appears to be entertained that having a soil analysed is a ready means of determining its manurial requirements or of obtaining an indication of its fertility. A brief discussion as to how far this view is correct may therefore serve a useful purpose.

A complete soil analysis includes chemical, physical and bacteriological investigations, and may be accompanied by general field observations for the purpose of ascertaining the nature of subsoil, the water supply, and climatic and other conditions important for the growth of plants. A full investigation of this kind, however, is very laborious, and in practice the analysis is usually less comprehensive, and aims not so much at giving a complete account of the soil as at determining the amounts of certain substances present in the soil which are known to have an important effect on crop production.

Experience has shown that a soil analysis is of little practical value when the interpretation is based on the results obtained from an isolated sample of soil from a district of which the analyst has no intimate knowledge. In certain special cases, e.g., where it is required to determine whether a soil is in need of liming, an analysis may be of great assistance to the farmer, but even where the investigation is a comprehensive one the analyst can only give a very incomplete idea of the general fertility of a particular field. It is difficult to place an absolute value on the results, and the element of uncertainty enters too largely into the interpretation. The difficulty will be appreciated if an attempt is made to obtain information as to the best system of manuring.

The analyst can determine as accurately as need be the percentages of nitrogen, phosphates and potash in the soil, but it has been found that, even where external factors such as climate, depth of soil, etc., do not enter into the case, there is often little or no connection between these percentages and

the soil's fertility or its manurial requirements. Any ordinary soil contains much more total plant food of all forms than a single crop of any kind can possibly require. Most of this plant food, however, is in a condition in which the plant cannot make immediate use of it, and is only gradually made available, the rate varying in different cases. As the plant can only make use of the free or available food, it is clear that it is possible for one soil containing quite small amounts of the manurial substances to produce better crops than another soil containing large quantities, if for any reason the first soil gives up its material to the plant at a more rapid rate than the second. In fact, some soils contain large quantities of nitrogen and still respond most readily to small dressings of manures containing available nitrogen, because practically all that is already in the soil is unavailable and as far as the plant is concerned might almost as well not be there at all. This also holds equally for phosphatic compounds; a soil may contain a good deal of phosphate and yet respond to more.

It is true that in the case of phosphates and potash a method has been devised of roughly measuring the amount which may be regarded as of immediate or prospective value to the plant, by ascertaining the quantity which is dissolved out in a given time by a weak solution of citric acid. This method gives results which in many cases indicate fairly well whether a particular soil will respond to an application of either of the two kinds of manure, and may be used in comparing soils of the same class. At the same time there are many cases where the results obtained are at variance with those obtained by actual experiment in the field, and so far no ready method has been discovered by which the availability of the nitrogen in the soil can be estimated, except as regards the small amount present in the form of nitrates or of ammonium salts. It will be seen, therefore, that chemical analysis of an isolated sample of soil can hardly be expected to supply a very accurate and reliable means of determining its manurial requirements, and it is probable that a simple field experiment would yield better results.

It is not only a question of what the soil contains but also of what the plant needs. A plant is a living thing and its needs are not constant but vary with the conditions under which it is grown. Thus a plant *needs* more phosphates on a clay soil than it would on a sandy soil, and it *needs* more potash on a sandy or peat soil than on a loam. Again a plant growing in a district receiving 32 or more inches of rain is in greater need of phosphates than in districts with less than 24 inches of rain.

Further, under present conditions an isolated mechanical analysis cannot be considered of much value to the farmer. By means of a mechanical analysis it is possible to measure the proportions of particles of different degrees of coarseness in the soil, and so determine to some extent the ability of the soil to meet the plants' requirements as regards the supply of water and the proper æration of the soil. At present, however, it is probable that an experienced farmer would be able to gain more useful and accurate information by examining the land carefully at different times of the year.

DIRECTIONS IN WHICH A SOIL ANALYSIS MAY BE USEFUL.

While isolated soil analyses are of little practical value at present, there are one or two directions in which an analysis can afford useful assistance.

1. A farmer may wish to know whether he has any reasonable chance of obtaining results similar to those demonstrated by field experiments on another farm in the locality. Where such experiments have shown the advantage of applying lime, phosphates or potash, the analyst can determine whether similar results are likely to be obtained on the soil which he analyses. The element of uncertainty will always be present, but there is every prospect that the advice will prove to be correct. In this way the farmer may be saved much time and expense in carrying out the experiment for himself.

2. A soil analysis may also prove of assistance where a farmer proposes to introduce a system of cropping or tillage known to give good results elsewhere in the locality, but before doing so wishes to compare his soil with that on which the system is successful. Analysis may reveal differences which although not obvious to casual inspection are of vital importance to the success of the enterprise. Two heavy soils, for instance, may look very similar, but one may owe its heaviness to very fine particles, and the other to silt particles, and methods successful in one case may prove failures in the other.

3. A farmer entering a new farm may wish to obtain complete information as to the possibilities of the soil, with a view to taking up some special branch of production, or ascertaining for what special crops the soil is suited. A soil analysis will show whether the soil and general conditions resemble those obtaining where the proposed system of farming is known to be a success. Where important differences are revealed the farmer may be able, with the assistance of the agricultural expert, to modify the scheme so as to adapt it to the possibilities of his soil.

It will be gathered from the above notes that the maximum assistance can only be obtained from a soil analysis when data are available for comparison with soils of the same type. Fortunately the country is now provided with organised schemes under which systematic investigations may be made and the results recorded. Soil surveys supplying fairly full information with regard to special classes of soil in a limited area, and carefully conducted field experiments, are being carried out in many parts of the country. As time goes on, therefore, the possibility of setting up comparisons will steadily increase and analyses will be of correspondingly greater value.

Before deciding to have a soil analysis carried out the farmer should apply to the County Agricultural Organiser, who will advise him whether material for a comparison is available and whether the analysis would be likely to give useful results.—BOARD OF AGRICULTURE AND FISHERIES LEAFLET.

SUPPLY OF MANURES.

The following notes with reference to the position as regards various kinds of fertilisers have been prepared by the Committee appointed by Lord Selborne to make arrangements with a view to the maintenance, so far as possible, of adequate supplies of fertilisers for the use of farmers in the United Kingdom.

Nitrate of Soda. Difficulties have arisen in procuring freight for the transport of nitrate of soda to this country. Farmers are advised to make arrangements to obtain their supplies for spring use through the ordinary channels without delay. A notice which has been issued to the Press on this subject appears at page 1018.

Sulphate of Ammonia. Arrangements were made by the Committee for a supply of sulphate of ammonia to be reserved for the use of farmers during November and December, 1915, at a fixed price. The question of the supply for spring use is now under consideration by the Committee, and it is hoped to make an announcement shortly.

Owing, however, to the shortage in the supply of sulphuric acid, makers of sulphate of ammonia are experiencing difficulty in maintaining their normal production. The use of nitre cake as a partial substitute for acid in making sulphate of ammonia is, however, under consideration.

Basic Slag.—As regards basic slag, the position is that while there is probably in the aggregate a sufficient production great difficulties are being experienced in securing delivery. Representations have been made by the Board to the Board of Trade and Railway Executive Committee, and it is believed that the railway companies are making every effort with the existing traffic, but the transport requirements of the military authorities and the shortage of labour make their position difficult.

The increased production of shell steel has, however, had an effect, on the proportion of phosphoric acid contained in the raw slag, so that there is a much smaller supply of high-grade basic slag than hitherto.

Superphosphate.—The supply of superphosphate is being affected at the present time by the shortage in the supply of sulphuric acid referred to above, and a reduction in the production of superphosphate owing to this cause seems unavoidable. A method of equalising the effect of the demand for acid among the different makers of superphosphate is under consideration.

Export.—The export of nitrate of soda is prohibited to all destinations, and no exceptions to this requirement are allowed.

The export of superphosphate, raw phosphate, basic slag, bones, bone meal, guano, sulphate of ammonia and potash is prohibited to all destinations other than British Possessions. No licences are being issued for the export of phosphate, superphosphate, basic slag or potash, but occasional applications for other articles are agreed to for special reasons.

With regard to the export of sulphate of ammonia, attention is drawn to a letter from MR. ACLAND which appeared in THE TIMES on the 22nd December, 1915, and which is printed below.

Early Delivery.—The Fertilisers Committee desire to impress upon farmers the importance of ordering their fertilisers and all other requirements well in advance in order to allow both for delays in transit and for difficulties in supply. At present a further rise in the price of all fertilisers seems probable.

EXPORTATIONS OF SULPHATE OF AMMONIA

The following letter, dated 22nd December, 1915, has been addressed to the Editor of THE TIMES by the Chairman of the Committee on Fertilisers

with reference to an Article which appeared in that paper on the 20th December last, headed "Feeding Stuffs for Neutrals—Farmers' Suspicions," in which it was suggested that the agricultural industry was being prejudiced by the special exportations of sulphate of ammonia which the Government were allowing :—

Sir,—The article in THE TIMES of the 20th December last, under the heading of "Feeding Stuffs for Neutrals" deals at some length with the subject of sulphate of ammonia. As I am the chairman of a Committee appointed by the President of the Board of Agriculture and Fisheries to take such steps as may be possible and advisable to ensure an adequate supply of fertilisers for the use of farmers, you will perhaps allow me to make one or two comments on the statements of your Agricultural Correspondent.

With the opinion that the farming interest has a right to claim that not a ton of fertilisers or feeding stuffs should be allowed to be exported until home requirements are fully met, I cordially agree, and I may add that this is precisely the policy which the Board of Agriculture has adopted since the outbreak of war. On the other hand, I deny with confidence the allegation that the claims of Agriculture are, or have at any time been, "set aside in an unintelligible desire to propitiate either commercial or foreign interests." The Board arranged in August, 1914, to collect monthly returns of the stocks of feeding stuffs and fertilisers, as well as of food-stuffs in the United Kingdom, and these returns have enabled us to watch very closely the actual supplies available from time to time. Only when the Board have been satisfied not only by the returns of stocks in hand but also by prospects of future supplies that the requirements of farmers were fully provided for, have they assented to exports.

It would, however, be of interest if your correspondent would indicate more clearly what he means by a full provision for home requirements, particularly in the case of sulphate of ammonia, which he selects as an example. The normal output of sulphate of ammonia, is about 400,000 tons per annum, and the normal exports are about three-fourths of the total, a considerable proportion of the remainder being used for industrial purposes. Is it suggested that farmers would use what must be considerably more than four times their usual quantity if exports were entirely prohibited? This would involve their spending about six million pounds on this one artificial manure—which is really unthinkable in the present agricultural circumstances. Or is it suggested that the same quantity would be produced if the market were restricted to the home demand? It is true that sulphate of ammonia is to a large extent a by-product of gas-making. But I understand that it is possible to make gas and at the same time considerably to reduce the production of sulphate of ammonia, and that this might be done if the supply were to exceed the demand over any considerable period. In that case the price of gas would rise, and the farmers would get no more fertiliser. This aspect of the matter is worth

consideration by those who advocate prohibition of export, not so much in order to secure ample supplies, but in order to lower prices. The effect of prohibition of export upon the Scottish shale-oil works and the coke ovens of the North of England ought also to be considered. Subject to the farmers' supplies being ample, the position of such industries is surely a matter for thought and attention.

With regard to supplies, the Committee propose to act in the future on the same general lines as in the past—namely, by an arrangement with the makers of sulphate of ammonia to reserve month by month an ample supply for agricultural requirements, and to assent to the export from time to time only of such quantities as are shown to be in excess of all home demands. Farmers have an entirely reasonable expectation of being able to obtain during the coming months an ample supply of all fertilisers which can be produced here in sufficient quantities. This expectation should not be encouraged to degenerate either into a groundless belief that such supplies will not be available, or into an unreasoning demand that all exports should be stopped—however ample the supplies may be which will be retained here. The farming community would show that good sense which, if I may say so, has generally characterised their attitude during the war, by looking into this question in the light of the available facts and figures, rather than by agitating in the manner which your correspondent suggests, without having the essential outlines of the subject before them.

Your obedient servant,

(Signed) F. D. ACLAND.

NEW PHILIPPINE OIL NUT.

The officials of the Commerce Department have received from Philippine sources an account of a new oil nut which has been discovered by accident in Manila. Twenty-five bags of an oil-bearing nut, supposed to be lumbang nuts, were sent and upon a test of the substitute for oil-bearing properties it was found to contain 45 per cent. of a dark, fatty, non-drying oil that made very good soap. The nut has a variety of names in the different provinces, and it appears that its uses for oil-bearing were known to the natives many years ago before the introduction of petroleum. The Philippine Manufacturing Company, of Manila, has made two shipments of the nuts, and the use of the oil in making soap is pronounced satisfactory.—Oil, Paint and Drug Reporter.

NOTES.

The value of Green Manuring, both as a means of enriching the soil and of maintaining its physical condition, is well recognised. There is, however, another rôle which it plays in this connection—that of increased æration of the roots of crops. The practice of green manuring, say Messrs. Harrison and Alger, by increasing the output of the soil gases, brings about an increased activity on the part of the bacteria in the soil surface film, resulting in an increased oxygen production and root æration, inducing a greater root development and cropping power.—W. I. Committee Circular.

A peculiarity of the Camphor Oil produced in the Federated Malay States is the absence of safrole to which constituent the oil produced in Japan largely owes its commercial value. It appears probable that the absence of safrole in samples so far collected is due to the fact that the distillate is obtained from young twigs and leaves in the F.M.S., whereas in the ordinary Japanese camphor oil of commerce, the distillate is derived from old wood from matured trees. The Agricultural Bulletin of the Federated Malay States (July 1915), from which this information is taken, adds further that a specimen of camphor oil distilled from leaves and twigs in German East Africa also contained no safrole.

In regard to National Education, Nature says: "It is time to understand that no man can now be considered to have received a liberal education unless he has some acquaintance with the principles and methods of science, and that works of Pasteur and Faraday should be as familiar to all as those of Victor Hugo and Tennyson. The training which ends in literary culture without science is just as incomplete as that which promotes scientific knowledge without the power of clear expression.

A very interesting question in Botanical Biology is that of bud variations, or 'sports' as gardeners call them. For some hitherto unexplained reasons, a plant may produce from one of its leaf buds a shoot which differs considerably from the rest of the present plants in foliage usually, sometimes also in flower and fruit. Such sports are usually carefully observed by a professional horticulturist; and in many cases they have become the origin of improved varieties of the present plant, or of varieties valued for their striking individual appearance. On the other hand, many of these bud variations are not stable, that is they are unable to give rise to a series of individuals

perpetuating their distinctive characters. In some instances, however, the original 'sport' gives rise to a series in which bud variation seems to run riot, each individual apparently being liable to throw out many different sports, some of them becoming stable, and others reverting to the form of their original parent.—Agric. News.

The following useful formula worked out by Mr. Henry Harries of London is taken from the Agric. News :—

To obtain the approximate yield of 1 inch boarding in a log, divide the mean girth in inches by 5 for the number of equivalent boards (b), multiply the result by the length (l) multiplied into the diameter (in feet to the nearest decimal) (d), for the yield in superficial feet (f).

An example may be given thus :—

Mean girth of log, 80 inches.. Length of log, 30 feet.

Then, $b \times l \times d = f = \frac{80}{5} \times 30 \times 2{\cdot}1$

$= 1{,}008$

By the first formula we get—

$$\frac{(\frac{80}{4})^2 \times 30}{12} = 1{,}000 \text{ superficial feet } (= f).$$

Particulars are given in the Monthly Magazine of the Incorporated Chamber of Commerce of Liverpool for September, 1915, as to the Cacao exported from the Gold Coast in 1914 and 1915. During the period January to December, 1914, there was exported 52,793 tons of cacao valued at £2,193,678. During the period January to June, 1915, there was shipped 46,632 tons valued at £1,720,666. It will be observed that the quantity shipped for only six months during the present year was nearly as great as that shipped during the whole of 1914, which points to a big annual figure for 1915.

EFFECT OF DETASSELLING ON MAIZE.

At a meeting of the Academy of Science at Paris in September, says Nature, a paper was read on the transmission, by seeds, of the effects of emasculation in maize stems. It has been shown that one effect of male castration in maize is to increase the amount of sugar in the stems. This has been carried out for four successive years, and it has now been proved that this increased proportion of sugar in the stems can be transmitted by the seed. It is interesting to speculate whether a similar treatment of the inflorescence might induce a similar change in the stem of the sugar-cane, which change, according to the principle established by the experiments of maize, one would expect to be transmitted.—Agric. News.

CO-OPERATION.

CO-OPERATIVE CATTLE INSURANCE.

[*Read before the Board of Agriculture at Jaffna.*]

In a paper read by me before this Board in November, 1914 (which appeared in the December number of the Tropical Agriculturist), I referred to the decrease of cattle in the Island, particularly in the more important centres of paddy cultivation, and I pointed out the need for adopting measures to provide for the tethering of live stock, the improvement of the breed of agricultural cattle and for replacing animals lost through various causes. I suggested the establishing of Co-operative Cattle Insurance Societies with the following objects:—(a) to provide an adequate supply of agricultural cattle, (b) to improve the local breed, (c) to conserve the health of the animals, and (d) to induce the villager to give more care to his stock. I referred to such countries as Burma which had successfully established these societies.

Since then I have had many enquiries as to how these societies could be engineered. I may mention that many have expressed doubts about their successful working in Ceylon. In this paper it is my intention to supply the information asked for, and give those who desire it an opportunity of criticising the scheme I have prepared for Ceylon.

Cattle Insurance Societies though new to Ceylon have, as I have already stated, proved a success in other countries, and if Burma has proved their utility I do not see why they cannot be adopted here, especially after our success with Co-operative Credit Societies, which were at first condemned by many as unsuited to local conditions.

It has been contended that the Ceylon cultivator has sufficient cattle to carry on his agricultural work, but the fact is that the number is on the decrease. A villager possesses some cattle, but the question is are they suitable for ploughing purposes, particularly for working implements of an improved type. From statistics available we are not able to discover the number of agricultural cattle. There is nothing to indicate the number of bulls, cows or young stock. In the absence of such information we have to depend on our own observation, which tells us that there is a deficiency of cattle to efficiently carry on agricultural work. I have figures which show the number of cattle slaughtered annually in 26 towns in the nine provinces in the Island. From these figures it will be seen that in 1913 no less than 53,243 head of cattle were slaughtered in the three municipalities and other local board towns in the Island. There are other smaller towns where cattle are slaughtered, but these are not reckoned. It would be a great matter if we could get at the birth and death rate per annum and also the number of plough cattle per 100 acres of cultivated land.

In some countries cattle insurance is a compulsory measure and State-aided, or the State assists in the formation of a central organisation to which local societies are affiliated. A proportion of the premium received by the

local societies goes to the central body which shares the indemnities in the same proportion. In this way risk is diffused and a large area covered.

It is desirable societies should cover only a limited number of villages.

Very young stock or old cattle should not be accepted for insurance. The age should range from 2 or 3 to 12 years. Sickly animals should also be excluded. The cattle should bear the brand mark of the society.

A member may join the society by paying an entrance fee and afterwards pay the premium. He may insure all his healthy cattle. In admitting cattle the maximum value of the animal should be fixed. Valuation may be checked by a committee appointed for the purpose. This committee may include the Government Veterinary Surgeon or his Assistant and two or more members of the society. Their valuation shall be final. As the animal grows the valuation may be checked annually or half yearly and premiums adjusted accordingly.

The rate of premium may be fixed in accordance with the risks involved. In some countries epizootic diseases are excluded from the risks. But in Ceylon there is likely to be no inducement unless such diseases are included and this is an important point for consideration. Sufficient care should be taken to exclude areas which are hotbeds of rinderpest, or to begin with let a particular class of animals, say plough and draught cattle, be dealt with. These animals receive more care at the hands of owners than others.

Where ordinary epizootic diseases are included the premium rate in Burma is 3 per cent. per annum per head, but this is increased to 6 per cent. if rinderpest is included. The whole value of the animal may be paid as compensation or a certain percentage of the value. No indemnity is paid for an insured animal if that animal dies within a certain period. Generally this period is taken as 15 days, which is the incubation period. After receiving an indemnity the member must continue to remain so for a certain period. No indemnity is paid to an owner whose cattle are insured where damage is done by a third party who is liable to pay compensation. When a death occurs the valuation committee must view the carcase of the animal and give the necessary certificate. When an insured animal is sold to an outsider the member may put in its place another animal which after the decision of the valuation committee may be registered in the books of the society. No compensation shall be paid when the damage is due to the neglect of the owner, if such neglect is proved at an enquiry held by the committee. The owner should observe the by-laws of the society and should take proper care of the animals. He should forthwith report any ailments of the animal to the Secretary, who should take proper steps to inform the nearest Government Veterinary Surgeon or his assistant. In this way greater attention is paid to the care of the animals, the dissemination of disease is controlled and cattle straying reduced to a minimum. The Managing Committee should supervise the work of other Committees, make such sanitary regulations as appear necessary and see that insured cattle are well looked after by the owners. Any breach of a by-law may lead to the loss of a claim on the society.

State-aid is to be expected if a satisfactory scheme is put forward. This will ease the hands of the societies on the financial side.

In Jaffna there does not appear to be any great risks on the score of epizootic diseases except, perhaps, foot and mouth disease; but cattle are said to suffer much owing to the want of pasture.

What mostly needed are (1) a systematic attempt to improve the local breed and (2) the provision of pasture land. On the death of a plough animal the owner who has no money to buy another has to borrow, paying 18 to 24 per cent. interest. Taking advantage of the absence of epizootic diseases in the district the premium rate can safely be made low to suit every one's pocket. The value of a country-bred animal being, say, Rs 50, the owner has to pay only a small amount as premium. On the death of the animal he need not go to the money lender to borrow at high interest, but can claim its value from the society. With the advantages secured by such a system as this, pasture and other difficulties are more easily overcome.

I have prepared a set of by-laws modelled on those of Burma and India, and these may be modified to suit special local conditions.

29th Feb. 1916. N. WICKREMARATNE.

LOSSES OF MOISTURE AND PLANT FOOD BY PERCOLATION.

G. S. FRAPS.

The results of three year's experiments made to ascertain the amount of percolation and evaporation from eight different soil types of Texas and the effect of cultivation, manure, and fertilizers upon the amount of water percolating and on the losses of plant food therein are reported. The soils used were Norfolk sand, Orangeburg fine sandy loam, Houston loam, Houston black clay, Yazoo clay, Miller fine sandy loam, Crawford clay, and Lufkin fine sandy loam.

Percolation was found to be greater through uncultivated clays and loams than through uncultivated sands and sandy loams. Cultivation increased percolation through the latter, but had little effect upon the former. Potassium sulphate and manure increased percolation through sandy soils but the former decreased percolation through clay soils. The fall application of manure was more effective in increasing percolation than the spring application.

The amount of nitrates in water percolating from uncultivated soils was related to a certain extent to the total nitrogen of soil and subsoil. More nitrate appeared in the percolates from manure applied in the fall than in the spring. An application of sodium nitrate increased the nitrates in the succeeding percolates of two of the soils, but with the other six no effect was observed until three or four weeks later. Only small quantities of potash appeared in the percolates from most of the soils, even after heavy applications of potash were made, the maximum loss being 12 cent. in three years from the Norfolk sand and the losses from the other soils varying from 0 to 4·5 per cent. From 9·7 to 66·6 lb. of potash per acre per year were lost by percolation from uncropped, uncultivated, and unfertilized soils, and the losses were to a certain extent related to the active potash of the soil. The losses of phosphoric acid in the percolates were very small, but the losses of lime were large, varying from 70 to 582 lb. per acre from the uncropped, uncultivated soils. The lime losses were in a general way related to the quantity of lime soluble in strong hydrochloric acid.—Experimental Station Record.

GENERAL.

CEYLON AGRICULTURAL SOCIETY.

PROGRESS REPORT LXIX.

MEETINGS.

The last meeting was held at the Galle Kachcheri on November 30th, 1915, the Hon'ble the Government Agent, Southern Province, presiding.

Mr. H. Amarasuriya read a paper on "Coconut Cultivation in the Southern Province," which gave rise to considerable discussion. Mr. Scherffius addressed the meeting on the subject of Tobacco Cultivation as a remunerative industry, and Mr. Corlett explained his system of irrigating and draining the paddy field at the Experiment Station, Peradeniya.

The staff of the Agricultural Department was represented by Messrs. Bamber, Corlett, Parsons, Bryce, and Campbell, besides the Director and the Secretary.

COCONUTS.

In response to enquiries as to the most approved method of treating coconut land, the Government Agricultural Chemist submitted the following useful memorandum on the subject :—

"The question of how best to treat coconut land depends on local conditions, and each case must be considered on its own merits.

"When we have a dry district with a soil possessing a low retentive power for moisture, where the rainfall is low and droughts occur periodically, the question of applying dry-farming principles—provided the soil is not too sandy—is well worth consideration in spite of the expense it involves.

"But where the rainfall is generous, the question of soil moisture is not so important and grass helps to save the surface soil from wash. But dry periods occur when the coconuts would be glad of the moisture the grass evaporates, and it would be well to anticipate this and do the ploughing just before the dry spell. The removal of plant food from the soil is considered an objection to grass-grown fields, but such plant food is as a rule returned to the soil in a more available form.

"A field should be well drained to cause the roots to descend and prevent them drying out during drought. The surface soil should be kept as well mulched as possible by turning it over and burying husks, leaf-waste, ashes of woody parts of the palm, etc. Cross ploughing up to within a few feet of the tree is necessary to turn over the soil in an economical manner. It is better to plough alternate rows at a time so as not to disturb the rooting system too much ; six months might intervene before the untreated rows are ploughed."

A communication was received from a London Syndicate with reference to a proposal to secure direct supplies of copra and the produce of the coconut palm generally, as owing to the general dislocation of trade in Europe it was felt that efforts should be made to provide fresh outlets for Colonial produce. The communication was referred to the Chamber of Commerce and the Low-country Products Association for necessary action.

A member writing from Veyangoda enquired if the following treatment was approved of :—A six-foot-radius circle was weeded round each tree and 10 lb. of lime applied at a distance of three feet round the tree. This was forked in and covered over with the grass and weeds removed. The Government Agricultural Chemist did not consider the amount of lime (about 600 lb. per acre) too great, but suggested that the area of application might be increased.

Another correspondent mentioned that he had applied 3 lb. of slaked lime per tree in November, 1913, and 6 lb. of artificials in November, 1914, and enquired if he might continue this treatment with advantage. The Government Agricultural Chemist was in favour of a larger dressing of lime every two or three years, as more frequent applications meant greater expense and unnecessary disturbance of the root system.

The Society has imported a kabyawan or Coconut rasper, an improvement on the familiar kitchen utensil commonly known as the coconut-scraper. For making oil from the fresh meat the process of scraping the kernel before boiling with water is a very tedious one, and an instrument like the kabyawan saves much time and trouble.

COPELAND thus describes the tool :—"The kabyawân is a convex iron burr mounted on the end of an axis around which a cord is wound several times and is then run down at each end to a pedal. The burr bears teeth all over its surface. The operator sits in such a position that his feet will conveniently work the pedals, pushing them down alternately and so whirling the axis and burr. The burr is pointed away from him so that when he takes a half-nut in his hands and draws it against the burr he can watch the removal of the meat. The apparatus makes an exceedingly effective rasp for the use of human power. In ordinary practice the meat is removed from a nut in about thirty seconds. Rasping a thousand nuts is regarded as more than a day's work except when the work is paid by the unit instead of by time."

MR. CASSIPILLAI, of Jaffna, first drew the attention of the Secretary to this new rasper, one of which is being fitted up to be worked by a treadle or hand wheel, and will in due time be exhibited to members.

PADDY (RICE).

At the Galle meeting the Organising Vice-President mentioned that an Instructor would be sent to Peradeniya to study the system of irrigation and drainage practised by the Manager, MR. D. S. CORLETT, with a view to seeing whether it could be adopted with advantage in the Southern Province. Accordingly MR. M. J. A. KARUNANAYAKE, Agric. Instructor, Hambantota District, was specially deputed to this work and visited the Experiment Station in company with MR. W. MOLEGODE, Senior Agricultural Instructor, on January 16th. He will report on the possibility of applying the system referred to particularly to the Tissamaharama fields.

The Secretary inspected MR. K. B. BEDDEWELA's trial plots in which six varieties of Philippine paddy are being grown. These varieties are being cultivated at Ampitiya. Owing to failure of rain the sowing was considerably delayed and eventually seed was planted and watered by hand. The delay resulted in the grain being attacked by the paddy-fly and subsequently by birds, necessitating careful watching. So far as can be judged at present the paddies are new to Ceylon and of fine quality, and should therefore prove a valuable acquisition.

The grain was expected to be ready for harvesting about end of February. The following table furnishes full details of the experiment :—

Days for Maturity Manila a/c.	No.	Name of Variety	Date Seed put to Germinate 1915.		Date Sown 1915.		Date Trans-planted 1915.		Approx. Date blossomed 1915.		Remarks.
179	527	Macan	Aug.	23	Sept.	1	,,	,,	Dec.	12	
171	692	Piniling Daniel	,,	30	,,	8	Nov.	13	,,	20	
169	447	Inasimang	,,	30	,,	8	Oct.	6*	,,	24	A
145	813	Senora II	Sept.	22	,,	29	Nov.	13	,,	12	
144	663	Panie	,,	23	,,	29	,,	13	,,	2	B
143	530	Maca Pinan	,,	24	Oct.	1	,,	13	,,	14	
143	635	Mulan-Ay (Mulanay)	,,	24	,,	1	,,	13	,,	14	

A. Some of this was issued to Manager, Expt. Station, Peradeniya, and is growing remarkably well there.

B. Blossomed and set earlier than dates given.

TOBACCO.

In view of the trouble which tobacco growers and dealers have lately experienced from the borer, the following information from the Director of Agriculture, Manila, will be welcomed :—

"This Bureau has perfected a machine to use in fumigating tobacco which has proven very effective in the control of this pest. An early report was published in the PHILIPPINE JOURNAL OF SCIENCE for February, 1913, describing a method of a different nature from the one recently devised, which was found moderately successful, but this Bureau is recommending only the latter scheme. The new system consists in placing the tobacco in an air-tight tank, reducing the pressure inside the tank by means of a vacuum pump to about a 27" vacuum and evaporating carbon bisulphide within the inclosure, afterwards pumping out the gas and replacing the same with normal atmosphere. A reproduction of the working plan of the tank, which was devised by MESSRS. D. B. MACKIE and J. T. ZIMMER of this Bureau, is being enclosed along with a copy of a preliminary report on the subject. A full report of the process will be sent you upon publication which is contemplated shortly. This Bureau is preparing to install a similar tank on a larger scale for use in fumigating quarantined shipments of plant material intended for exportation or being imported."

The copy of the preliminary report and plan referred to can be seen at the Society's office.

FRUIT CULTIVATION.

A consignment of the following grafted fruit plants was received from Bangalore on the order of members :—Orange 125, Mango 85, Figs 20 Grapes 15, Guava 24, Lime 72, Pomegranate 20, Pomelo 6, Lemon 3, Sweet-lime 3, Mandarins 6.

6 Gootee layers of the seedless Pomelo of Siam were secured through the kindness of MR. D. S. BLAZE of the F. M. S.

Seeds and plants of the Persimmon (*Diospyros kaki*) are now available at the Government Stock Garden. This small tree which is suitable for growing at elevations between 3 and 6,000 feet has been fruiting at Bandarawela.

It will interest members to learn that the grafts of Sapodilla (*Achras Sapota*) from Calcutta, which have turned out so well, are standing on *Mimusops hexandra* stocks. For this information thanks are due to the Superintendent of the Agri-Horticultural Society of Madras. *Mimusops hexandra* is "Palu," one of our commonest forest trees in the dry district, the timber of which is used for railway sleepers. Seedlings of this plant will be raised at the Government Stock Garden for future use as stocks.

The Calcutta Sapodilla at the Stock Garden which began to bear 3 years ago has never gone out of fruit. A good many Gootee layers have been established from it.

VEGETABLE CULTIVATION.

The usual half-yearly distribution of vegetable seeds was made in May. The seeds came from MESSRS. SUTTON & SONS, and were of excellent quality.

The cultivation of vegetables is spreading rapidly, and during a recent visit to Tamankaduwa district it was gratifying to find that a number of gardens at Mineri and Topawewe had sprung up as a result of the Society's work through its Instructors.

Tubers of the Chinese artichoke (*Stachys tuberifera*) have been received from the Director of Agriculture, Burmah. This is considered in Burmah to be one of the finest and most delicious vegetables. It is easily cultivated, growing in almost any soil, though a rich loam is most suitable. Tubers raised locally will not be available for distribution for some time yet: the fact will be announced after the crop is gathered.

PESTS AND DISEASES.

The following advice was kindly furnished by the Assistant Government Entomologist on specimens submitted :—

(1) Insects found on diseased bark of the mandarin orange forwarded by MR. MADANAYAKE, Agricultural Instructor, from Bentota. The insects are minute and allied to the "red spider" of tea. The affected trees (particularly the bark) should be dusted with flowers of sulphur or sprayed with a contact poison such as kerosene emulsion.

(2) Diseased plantain shoot forwarded by the teacher, Government Girls' School, Uda Aludeniya. The root stock was found to have harboured no less than three kinds of pests, (a) the grubs of a weevil (probably *Cosmopolites sordidus*) (b) a species of *Aphis*, and (c) a Myriopod. I consider the weevil the primary cause of the trouble and the only really serious pest. All unhealthy looking plants should be dug out and burnt or buried at least three feet deep with a good quantity of lime. It is useless to attempt saving the tree when once affected, and all measures adopted should be of a preventive nature.

MR. MOLEGODE reports that kerosene emulsion sprayed twice a week on Aphides attacking Cho-cho (*Sechium edule*) entirely got rid of the pest.

Against insects (probably a species of *Tenebroides*) damaging tobacco in bulk at Teldeniya treatment with bisulphide of carbon or hydrocyanic acid gas and storage in insect-proof bins were recommended.

The *Brassolis Sophorœ* caterpillar damaging coconuts in British Guiana is, according to the Government Entomologist, confined to that Colony and does not occur in Ceylon.

The F.M.S. AGRICULTURAL BULLETIN describes a disease of Cinnamon caused by *Pestalozzia palmarum* which is the cause of "Grey Blight" on

Coconuts. The Government Mycologist states that this fungus does not attack cinnamon stems to any appreciable extent, though "red rust" has been recorded.

Phoma destructiva on the Tomato and *Pseudomonas citri* causing a citrus canker (described in the Journal of Agricultural Research) are both not recorded for Ceylon. The Ceylon tomato disease is according to the Government Mycologist caused by a *Phytophora* analogous to the potato disease, while our citrus canker is caused by *Corticium*.

POULTRY.

The following is the scheme for the improvement of poultry in the villages proposed by Dr. H. M. Fernando, who has offered to supply the necessary funds :—Teachers of selected schools will be supplied free with a pen of poultry (one cock and 4 pullets) of pure Leghorn breed. The eggs from this pen are to be sold to the school boys at ordinary rates on the understanding that they should be used only for hatching purposes. The proceeds of such sales will be the property of the teacher.

At the end of a year a prize of Rs. 5 will be awarded to the best pair of *pure-bred* birds reared by the boys in their own houses at each centre. No country-bred fowls will be allowed to mix with the pure breed, which means that no other poultry except those supplied to the teacher will be housed in the school compound.

Careful records will be kept of the eggs laid and distributed.

The pens will be periodically inspected by the Superintendent of School Gardens and his Inspectors.

LAC.

Brood lac of good quality from *Zizyphus* trees at the Government Stock Garden, Colombo, was sent to Jaffna and Tangalle for inoculation purposes.

Mr. N. Wickremaratne, who has studied lac culture in North India, has drawn the attention of cultivators to the necessity for having two sets of trees. While the lac is developing on one set, the other should be putting out new growth after pruning, so as to provide food for the next crop. To keep on raising lac on the same trees, without giving them a rest or pruning so as to induce new growth, is bound to end in failure as the demand on the resources of the trees is too great to enable it to resist the naturally weakening effect of the parasitism.

A fresh lot of brood lac has been indented for from India.

It is interesting to note that the export of lac from India during the year 1914-15 amounted to 366,161 cwt. valued at Rs. 16,057,709.

CO-OPERATIVE CREDIT SOCIETIES.

In spite of recent events and the tightness of the money market these societies are making satisfactory progress. The Hinidum Pattu and Kalapaluwawa societies obtained loans from Government, and applications have been received for loans from others.

It is most gratifying to note the very satisfactory progress of the three societies in the remote Wellassa division in Uva province which have a membership of 1,397.

The total number of societies at the end of last financial year was 54, the number of members 3,850, the paid-up capital Rs. 18,832·50, the amount of loans outstanding Rs. 15,310·09.

Most of the societies are purely agricultural in character and receive assistance from the Ceylon Agricultural Society. The Hinidum Pattu society is experimenting with a new strain of paddy supplied by that body. The Hataraliyadda Society distributed cluster sweet potato cuttings among

members, and is about to undertake experiments in improved methods of paddy cultivation. The Walapane and Wellassa societies propose to establish experimental gardens.

AGRICULTURAL EDUCATION.

The opening of the School of Tropical Agriculture at Peradeniya referred to in the previous report duly took place on the 15th of January in the presence of a large and distinguished assembly. The Director recounted the history of the movement which culminated in the establishing of the School, and the Hon'ble Sir Anton Bertram (Attorney-General) delivered an oration calculated to fire the enthusiasm of all connected with the new institution, whether as teachers or learners. Altogether the School was launched under the most favourable auspices with offers of medals and prizes from such well-known philanthropists as the Hon'ble Mr. A. J. R. de Soysa, Mudaliyar A. E. Rajapakse, and Mr. H. Amarasuriya, while the Low-country Products Association signified through its Secretary, Mr. H. L. de Mel, its practical interest by offering to employ a number of men trained at the School.

The present roll of students is made up of 34 boarders and 32 day scholars, 6 being vernacular students in training as schoolmasters.

Mr. R. N. Lyne, Director of Agriculture, is the Principal and Mr. C. Drieberg, Secretary of this Society, the Vice-Principal of the institution, while the Registrar and Headmaster is Mr. L. St. H. de Zylva who comes from Trinity College, Kandy, with excellent qualifications for school organisation work.

The Society contributed a sum of Rs. 1,200 towards the cost of erecting the class-rooms.

MISCELLANEOUS.

The Spinning and Weaving Co., Ltd., Colombo, are prepared to purchase seed cotton at 12½ cents per lb. or Rs. 14 per cwt. The produce of last year's crop (Allen's Long Staple) from the Hettipola Garden was sold at this rate.

A sample of *Caulo cotton* (see Tropical Agriculturist for June 1915, p. 392), was received from the Foreman of the Government Stock Garden and submitted to the Manager, Experiment Station, Peradeniya, who reported on the lint as follows: White and clean but harsh; strong; about 1 inch in length but irregular.

The Agricultural Chemist in discussing the use of *lime* as a substitute for potash says: "There is no chalk or soft limestone to my knowledge in Ceylon, but several outcrops of more or less dolomitic limestone occur. The latter is not suitable for manurial purposes. Coral and shells are the most suitable material for lime-burning for agricultural use."

Replying to an enquiry about the market for *Sapan wood* (the product of *Cæsalpinia sapan*), Messrs. Hayley and Kenney, Colombo, report "The price for Sapanwood before the war commenced was about Rs. 40 per ton delivered in Colombo. The high rate of freight and the difficulty in obtaining the same since the war commenced have absolutely killed the business and therefore it is difficult to name a rate now. We should put it down at nominally Rs. 25, but if freight were obtainable it is possible that London buyers would now pay higher rates.

Messrs. Chas. P. Hayley and Co., Galle, report "Sapanwood is worth about Rs. 40 per ton, but we are not in the market for same at present."

Among recent introductions is the *Pistachio nut* (*Pistachio vera*) kindly procured for the Society by the Agricultural Officer, N. W. F. Province, Taru, near Peshawar.

The Society's *Stud Bull* has been sent from Hambantota to Mahaoya and is now in charge of the Ratemahatmaya of Bintenne (E. P.). The animal is of the Kangayam breed which is in high repute in South India. It was first stationed for one year in the Jaffna peninsula and for another in Magam Pattu.

The Secretary has received from the Director of the Imperial Institute copies of a monograph on *Oil Seeds and Feeding Cakes*. These are available to anyone specially interested in the subject.

Dr. P. M. Muttukumaru of Bandarawela who is growing imported varieties of *grapes* is prepared to supply rooted cuttings. Members should apply direct to him for information as to price and varieties available.

Mr. M. J. A. Karunanayake, Agricultural Instructor, is growing an acre of *tobacco* at Ambalantota Gardens in the Hambantota district. The land was first put under sunn hemp (sown in July last) which was dug in October, and subsequently worked to a depth of 18 inches. Seedlings raised from Dumbara seed were planted out 4 × 4 ft. apart in the 2nd week of December and the crop is reported to be coming on nicely.

The Assistant Government Agent, Puttalam, referring to the seeds of the *African oil palm* distributed last year writes: "the palms have taken root and are getting on well so far;" the Government Agent, Eastern Province reports that "the palms are flourishing:" at Hambantota and Mullativu one palm each has been established.

The Black Russian *Sunflower* was grown experimentally at several centres and formed flower heads. Excellent specimens were received from Mr. Senior White (Matale). Unfortunately a large percentage of the seed was found to be imperfectly developed and is therefore useless for propagation as well as for oil-production.

Mr. Senior White has furnished the following details of his experiment:—

"A plot of land 1/100 acre in extent, previously in Guinea grass and weeds, was deep forked, and an application of ½ bushel lime given. The seed germinated on the 23rd and the plot was interplanted with Wela (*Gynandropsis*). This was cut after a month and mulched round the young sunflower. Flower-heads appeared at the end of November and were cut as seeds ripened. The whole crop gathered by 14th January and yielded at the rate of 50 bushels (1,250 lb.) of seed per acre."

The Government Agricultural Chemist reports as follows:—

"There is no demand for Sunflower seed or oil in Ceylon and experiments at Peradeniya showed that while the plants (Russian) grew luxuriantly and formed large heads, they contained only one or 2 per cent. of fertile seed, the other seed being empty. Both the seed and oil are valuable in England, but I cannot quote recent prices. The stalks of the plant are said to yield a valuable supply of potash and it might well be tried in the North-Central Province and in the Welimada district to ascertain the value. If one or two cwt. were sent to the Experiment Station the oil and cake could be manufactured and valuations of both obtained. It was suggested to grow the seed for oil purposes for use in canning sardines in the Trincomalie district, but the imperfect fertilisation of the flowers rendered the experiment negative. Possibly better results would be obtained in drier districts."

The Society's Year-book will re-appear in an improved form at the end of this year. Mr. Molegode, Senior Agricultural Instructor, has compiled a useful handbook on Vegetable Cultivation which should find its way into our book-shelves as a convenient work of reference. Copies could be had by Members on application to this office at Re. 1 each.

C. DRIEBERG,
Secretary, C.A.S.

Peradeniya,
29th February, 1916.

FELLING TREES.

So many regrettable accidents have lately occurred, resulting in some cases in the loss of valuable lives of those engaged in scrub felling and timber-getting, that a few suggestions, as follow, by one who has been engaged in both occupations may be considered worthy of noting.

Felling a tree scientifically is an art gained by long practice. We are dealing now with saw work. The first thing to be done is to ring the tree, removing a ring of bark about 6 in. wide all round, exposing the sap wood. The saw is then entered on the leaning side. If the tree be absolutely perpendicular, a survey of the branches above will clearly indicate to which side the tree will incline when felling. It will naturally fall on the side of the heaviest limbs. In such a case the cut is begun on that side. To ensure a perfectly horizontal cut, the saw must be held horizontally, care being taken to keep the back up, as it tends to sag downwards, until it has entered far enough to rest on the lower side of the cut. But still the back must be kept up, for, if cutting proceeds with the back resting, the cut will naturally take an upward direction.

Having entered the saw to a depth not further than nor even quite so far as the centre of the tree, withdraw the saw. Here I may remark that when a tree has a considerable lean, the saw should be withdrawn as soon as it is in the least pinched by the coming together of the two parts of the cut. Cases have occurred in which the saw has moved fairly freely, and yet could not be withdrawn owing to the cut having closed behind it. In such a case nothing remains to be done but to chop the saw out, unless it has a removable eye, and then, of course, it can be withdrawn through the cut, so long as it has motion at all. Having now entered the saw as deeply as the hang of the tree will allow, or, in the case of a perpendicular tree, almost to the centre (although to one-third of the diameter is preferable), the sawyers go to the opposite side of the tree and again enter the saw. Now it is that great care and nicety are required. If the new cut is begun too low, either there will be a great labour in wedging the tree off at the last, or it may fall towards the lower cut, and loss of life may ensue. If the cut be too high, over half the first log will be some inches longer than the remainder, and as a consequence the rails, post, or whatever is to be split from it will be of unequal length and form a "job lot," entailing extra work on the fencer.

I have known men to hit the first (or belly cut) so exactly with the back cut that, except for the unavoidable splintering of the last fibres of wood holding the tree up, none could have told that the two were not a single cut. I had a mate who always drew a charcoal line round the butt of the tree, and worked to that line so truly that we rarely had a difference in the stuff split from the butt log.

Now come some of the niceties of felling, which are adopted to ensure the safety of the timber-getter and also the soundness of the log. Many a tree has split up before being two-thirds cut through by badly managing the final cutting, especially in a high wind. But I would not advise anyone to attempt to fell heavy timber during a gale of wind. I have tried it on two or three occasions, and always with loss.

The usual result is what is technically known as a "kick up."

This is caused in the following manner:—The tree is a slightly leaning one; a heavy breeze is blowing; a deep belly cut has been put in. The back cut has got well in, and the tree is a free running one. Each pull of the saw weakens the remaining wood. Suddenly a gust of wind seizes the top of the tree, which leans over and splits from the depth of the back cut to a length of perhaps 15 ft. Then one of two things happens. Either the

back half of the tree, breaking off from the lower half, makes a wild flight into the air and comes down suddenly with terrific force, some distance to the right or left of the stump, or else it does not break right away, but remains suspended. In either case the tree is useless to the splitter. I shall presently show the great danger which exists in this and other cases to human life. Meanwhile I will proceed to fell the tree which has been waiting for us. Having got the saw in to a little over its own depth (in a tree 3 ft. in diameter, say) in the back cut, if you hear no cracking sound you may go on sawing till you reach a depth of 15 or 16 in. Now, without withdrawing the saw, move round to one side gradually, continuing to cut as you go. This is cutting out the "quarters." You do this on both sides till your quarter cuts join the belly cut. The quarters must be deeply cut in, as it is this work which prevents the tree, if a free one, from kicking up and splitting. Now you go back to the back cut, and as there is now plenty of room behind the saw you insert one or more wedges.

Although the time to decide where a tree shall fall is before commencing to cut (the belly cut always being put in on the falling side), yet the needful direction can be given by the judicious use of wedges. Another great help is to cut a notch out of the stump, leaving the butt projecting about 3 in.

This notch serves a double purpose. It leads the tree in the direction in which it is to fall, and it quite prevents the tree from slipping back on the stump (as often occurs), and rushing backwards over it for many feet like a battering-ram. I have known men killed by a tree doing this, and I saw a most miraculous escape of a mate of mine when we were felling an enormous ironbark at the Pimpama, at Ormeau. The tree was nearly 6 ft. in diameter, and rose perfectly perpendicular to a height of about 50 ft. to the first branch. We cut this tree completely through, so that it actually spun on the wedges, which would take no effect on it. We, of course, stood at the stump waiting till it should begin to fall, when we would step back quietly. Suddenly the tree, probably acted upon by a light puff of air up aloft, turned slightly and began to fall in the direction in which we were standing. It then slipped over the stump. My mate, instead of standing his ground coolly, became panic-stricken, and ran right in the track the huge tree was shooting along, supported on the stump. Just as the butt reached him he fell, and I saw that enormous tree rear up 20 ft. in the air and come down with a crash within a foot or so of the fallen man. At Indooroopilly a man was jammed 3 ft. into the earth by a big tree acting in like manner. It not only killed, but actually dug his grave and buried him.

However, we shall never get our tree down at this rate. We have made the belly cut, the back and quarter cuts; we have notched our stump, and now you may put your wedges in. If you wish the tree to fall towards the right a little, hammer up your left-hand wedge with the maul, and keep on pounding until the maul rebounds with a dull thud. That is a sign that the wedge will go no further till the wood is further cut. Now go to work with the saw again. Cut well in at the quarters; then cut out the back wood. Keep hammering up your wedges. Now when you hear the tree begin to crack, you must keep your nerve and stick to the saw. Saw as hard and as quickly as you can, so as to cut the last inch, if possible, before the final separation takes place. As the tree gracefully bows its head for the crash, *on no account run away*. Stand fast, even with your hand on the falling giant, till you are quite sure that it is going clear on to the spot you decided on. *Then* step well clear, for a tree on striking the ground often rears up its butt like a dying whale its tail, and brings it down with a flop, perhaps 6 ft. to either side, but you have, meanwhile, quickly got 6 ft. away from danger. Running away is the most dangerous thing a man can do when

felling a tree with the saw. When felling with an axe there is no need to run, for the tree in falling jumps forward clear of the stump and never "goes back on you.'

When timber-getting in a scrub, the timber-getter runs the gauntlet of several dangers. First, the head of the chosen tree is often out of sight. Next, it is usually bound to hundreds of other trees by stout lianas or vines; vegetable ropes that hold it up, even when cut through, and cause it to defy any attempts at directing its fall. Then the sawyer is surrounded and hampered by thick-growing brushwood and young saplings, interspersed with "lawyer" and other troublesome vines. Perhaps at the foot of the tree, where the foot would rest in working the saw, there is a large jumper ants' nest, and not unfrequently a fine snake comes crawling along to see how matters stand. So that the sawyer has to look into the air, on to the ground, and watch his work at the same time. The first thing to do here is, of course, to provide an avenue of escape, by clearing away vines and undergrowth, if not all round, at least to the width of a clear track.

Should a gust of wind suddenly force the tree towards the back cut, the saw will inevitably be jammed. If the tree refuses to answer to wedges and gets a decidedly wrong lean, it is useless to try and release the saw. Wrenching at it will only result in "buckling" it. Besides, in such a case, the tree is liable to fall at any moment, and in any direction except the right one. The best thing to do is to let go the saw and await developments. The tree *may* go back if the breeze dies away. When this happens, ram in your wedges as quickly as possible, and go on sawing.

I once saw a marvellous escape from death, resulting from such an accident as I have described. My mate and I were timber-getting above the Seventeen-mile Rocks, on the Brisbane River, in 1863. We got the saw jammed by a gust of wind. He stuck to the saw whilst the tree was groaning and cracking. I called to him to let go. Instead of doing so, he actually got in front of the tree, and caught the saw on both sides protruding from the cut, to try and work it out. Suddenly the tree fell. He just had time to throw himself at full length alongside a dead log. I saw the big tree crashing down across the log, which looked old and rotten. If it were crushed, then I would have to pick up what was left of my mate and hold a private inquest. He sang out: "Good-bye lad; I'm done." But he was anything but done. The log was solid. His first move on crawling out was towards his beloved saw. "There! I knew it would be buckled." Not a word about his wonderful escape, which seemed to him but an ordinary circumstance.

Now, one word about working the saw. Some inexperienced men, in fact all, think that by laying their weight into it they are doing good work. This is their mistake. The saw should run easily, no violent pressure being placed on it. Especially in felling a tree is it essential that each man should give to the other. If one man keeps digging the saw in, he drags the other after him. I have sometimes allowed a new chum to pull me round from the back to the belly cut, and he has wondered how it happened. It is the same when cross-cutting. The saw should run easily, working by its own weight. No undue pressure is required.

It is not a bad idea, when felling a tree, to lay a couple of small logs at about 10 ft. apart, and le the tree fall on them. This raises the butt from the ground and admits of easy cross-cutting without any more wedging than is necessary to keep the cut open to allow of the free running of the saw.—Queensland Agricultural Journal.

LATENT LIFE.

THE GARDENERS' CHRONICLE in an article on latent life asks: What is the nature of latent life which many plants and some animals exhibit when outward circumstances are untoward? During this period are all vital functions in abeyance, and are the seeds or plants in a state of suspended animation, or are the life processes still carried on albeit at an almost infinitely slow rate? Over these questions philosophers have puzzled and quarrelled. Some have urged and claimed to prove that in the dormant seed life is suspended altogether. To express this condition they have coined the term latent life. Others deny the possibility of such a living death susceptible of such a resurrection, and maintain that, whilst the seed or plant sleeps deeply, breathing and such like processes still go on, although at the slowest rate. To them the dormant plant is living, and they speak of its life as une vie ralentie, a dead-slow life.

Nor is the problem one to interest only academic philosophers. Great issues may depend on the answer. For example, if a resting seed is indeed in a state of suspended animation—capable of life, and yet using up none of its store of energy—it follows that, provided the conditions are favourable to the continuance of the resting state, that seed might remain for æons.

The dispute between the rival theories of latent life and relaxed life seems to have been finally settled in favour of the former, for PROFESSOR BECQUEREL has shown that it is possible, by very thorough drying, to keep seeds in conditions in which life processes cannot go on as, for example, in an almost complete vacuum, without destroying their capacity for germination. He, as well as others, have also proved that thoroughly well-dried seeds may be subjected to exceedingly low temperatures, for example, 250° C. below zero, without impairing their powers of germination.

PUPATION AND OVERWINTERING OF THE HOUSE FLY.

C. G. HEWITT.

The results of careful investigations of soil subjacent to heaps of manure, made with a view to determining the distances and depth to which house fly larvæ migrate prior to pupation, are reported upon and diagrammatically illustrated. "A few puparia were found directly beneath the manure pile to a depth of 12 in. The greatest numbers occurred in the region about 18 in. from the pile and at a depth of 12 in. to 2 ft. from the surface.....the puparia were also numerous immediately below the surface of the soil. The numbers then gradually decreased proportional to the distance from the pile and dwindled away at a distance of about 4 ft. from its base."

As regards the overwintering of the house fly, the author states that in no case has he been able to find living pupæ of *M. domestica* under outdoor conditions during the winter in either England or Canada. Neither has it been possible in breeding experiments in Canada or England to carry it through the winter in the pupal stage. He recognizes the possibility, however, that it may do so in a more southern latitude.—EXPT. STN. REC.

GREAT STUDENTS OF PLANT LIFE.

THE BROOKLYN BOTANIC GARDENS RECORD for October last publishes a list of the most notable workers in the field of Botany who have contributed towards our present knowledge of the science. Living botanists are not included in the list of names which is worth recording for future reference.

Cleidemus (quoted by Aristotle). Earliest plant pathologist.

Hippon (quoted by Aristotle). Taught that cultivated plants are derived from wild ones.

Aristotle. Established at Athens the first botanical garden of which we have record. Teacher of Theophrastus.

Dioscorides (cir. 64 A.D.). Medical botany. Phytography.

Theophrastus (B.C. 370-286). Improved the Athens Garden with financial aid from Demetrius Phalerius. Author of the oldest treatise on pure botany.

Ghini. First to use dried plants for scientific study. Teacher of Cesalpino.

Bauhin (1650). Distinguished species from genus, and described species.

Plinius Secundus (A.D. 23-79). Wrote fifteen books on botany. Is credited by Adanson with being the first to distinguish growth buds from fruit buds in trees.

Brunfels (1464-1534). Reformation of Latin nomenclature. Early herbalist.

Fuchs (1501-1566). Economic botany. First attempt to establish a botanical terminology.

Trojus (1498-1554). First book of systematic plant description.

Ericius Cordus (1486-1535). First showed that the plants named by the ancient Greeks and Arabs do not grow in middle Europe and cannot be identified in the local flora.

Valerius Cordus (1515-1544). First named "pollen." First to establish *many* (more than one or two) new genera. First to observe and describe right and left hand mutation and twining. First to describe *sundew*. First to describe the occurrence of root tubercles (on garden lupine). Combated fallacy of the importance of the root. First to urge botanists to cease copying the descriptions of the ancients and to describe anew from nature.

Meyer. (Ernest). "Historian of botany."

L'Ecluse. Director of Botanic Garden at Leyden, 1577.

Aldrovandi. Director of Botanic Garden at Bologna, 1567. First (with Cesalpino) to form herbarium. Pupil of Ghini.

Ratzenberger. Formed one of the first herbariums in the modern sense—1599 (?)—at Cassel.

Gesner (1516-1565). Emphasized importance of flower and fruit in determining affinities.

Cesalpino (1519-1603). "Created epoch of modern botany." First (with Aldrovandi) to form herbarium. Pupil of Ghini. Comparative morphology.

Jung (1587-1657). Invented comparative terminology for parts of plants. Interpreted compound leaf.

Morison (1620-1683). First to form a genealogical tree.

Ray (1628-1705). One of the first to call attention to monocotyly and dixcotyly and to endosperm in seeds. Accepted idea of a difference in sex in plants.

Bachmann (1652-1725). Urged the advantage of binomials.

Tournefort (1656-1708). First defined limits of genera.

Adanson (1727-1806). Separated families. Discovered movements of *Oscillatoriæ*. Historian of botany.

Linnæus (1707-1778). Father of modern systematic botany.

Bernard de Jussieu (1699-1776). Advanced the natural system.

A. L. de Jussieu (1748-1836). Assigned characters to families.

Gartner (1732-1791). Spores different from seeds. Distinguished endosperm from cotyledons.

A. P. de Candolle (1778-1841). Distinguished between morphological and physiological marks.

Robert Brown (1773-1858). Discovered nucleus. Gymnospermy of Conifers and Cycads.

Endlicher (1804-1849). First to divide plants into Thallophytes and Cormophytes.

Lindley (1799-1865). Advanced systematic botany.

Schmidel (1718-1792). Sexual organs of liverworts

Hedwig (1730-1799). Sexual organs of mosses. Founder of scientific knowledge of mosses.

Vaucher. Sexual reproduction of Spirogyra.

? Goethe. Metamorphosis.

? Leonardo da Vinci. Interpreted annual "rings" of growth of trees.

Nees von Esenbeck. First cultivated *Mucor stolonifer*.

Karl Adolph Agardh (1785-1859). Swedish systematist.

Jacob Georg Agardh (1813-0000). Swedish systematist.

Du Petit-Thouars (1758-1831). Director, Botanic Garden at Roule.

Schimper (1808-1880). Spiral theory of phyllotaxy.

Braun (A). The shoot the morphological individual.

Carl Nageli (1817-1891). Apical-cell. The cell the starting point of morphology. Cell formation and division. Gave name "primary meristem," and explained its significance. Starch grains. Growth by intussusception.

Bischoff (1797-1854). Marchanticæ. Germination of vascular cryptogams. First saw spermatozoids of Chara.

Malpighi (1628-1694). Plant anatomy. First observed bordered pits. Gave first account of the development of the seed.

Grew (1628-1711). Coined term *parenchyma*. First saw stomata (on ferns).

Leeuwenhoek (1632-1723). Lenses. First to see crystals in plant cells (e.g., *Iris and Smilax*).

Wolff (1733-1794). Epigenesis.

Amici. Intercellular spaces contain air vis. sap. First to observe that pollen tubes enter the micropyle.

Comparetti. First observed opening and closing of stomata.

Bernhardi. Discovered annular vessels. The spiral threads are surrounded by a membrane.

Link (1767-1851). All thallophytes are plants, and the filaments of lichens and fungi consist of cells.

Treviranus (1799-1864). Discovered intercellular spaces in parenchyma. Discovered stomata on capsule of mosses.

BENINGA (1815-1871). Advanced our knowledge of the structure of the moss-capsule.

TRENTEPOHL. First observed escape and swarmings of zoospores of *Vaucheria*.

THURET (1853). Fertilization in *Fucus*.

PRINGSHEIM. Sexual process in *Vaucheria*, etc. Alternation of generations in Muscineæ. Conjugation of swarm spores in Volvoxineæ.

COHN. Sexual formation of spores in *Staeroplea*.

MICHELI (1679-1737). Director of Botanic Garden at Florence. Observed development of fungi from spores.

EHRENBERG. First described sexuality in a mould. (Conjugation in *Syzygites*).

SCHWENDENER. First declared true nature of Lichenes.

HOOK (1635-1703). Improved microscope. Discovered cellular structure of plants.

MIRBEL (1776-1854). Founder of vegetable histology in France. All plant tissue is modified parenchyma. Study of *Marchantia*.

MOLDENHAWER (1766-1827). First to employ maceration for separating vessels and woody cells, and established dual nature of the cell-wall between adjacent cells. Dispelled error that outer layers of wood are formed from the inner bast.

MEYEN (1804-1840). Introduced terms *prosenchyma*, etc. Explorer; prolific writer.

VON MOHL (1805-1872). Cell formation. First described vegetative cell-division. Phytotomy. The cell the foundation of plant structure. Explained lenticels. Gave the name "protoplasm."

PAYEN (1795-1871). Walls of plant cells are of cellulose. Starch-studies. Discovered (with PERSOZ) diastase.

SCHLEIDEN (b. 1804). Cell-theory.

UNGER (1800-1870). "Anatomie und Physiologie der Pflanzen."

SCHACHT (1824-1864). "Die Pflanzenzelle." Mode of formation of bordered pits.

THEODOR HARTIG. Discovered sieve-tubes.

DEBARY. Fungi. Comparative anatomy.

BRONGNIART (1801-1876). Observed (1826) germination of pollen in stigma, and (1827) the formation of pollen grains in pollen mother cells.

EICHLER. Morphology of the flower (1875-1878).

PAYER. Morphology of the flower (1857).

VAN TIEGHEM. Physiology.

WARD (MARSHALL). Dendrology.

MULLER (HERMANN). Pollination.

MULLER (FRITZ) Pollination.

DELPINO. Pollination.

HILDEBRAND. Pollination.

BENTHAM. Systematic.

HOOKER (W. J.) Systematic. First Director of Kew Gardens.

HOOKER (SIR J. D.) Systematic. Second Director of Kew Gardens.

RENAULT. Fossil botany.

SOLMS-LAUBACH. Fossil botany.

RADLKOFER. Systematic anatomy.

SOLEREDER. Systematic anatomy.

CAMERARIUS (1665-1721). Discovered sexuality in plant.

GLEDITSCH. Director, Botanical Garden, Berlin. Experimental study of pollination and sex in plants.

KOLLREUTER (1733-1806). Director Botanic and Grand Ducal Garden in Carlsrühe from 1768-1786. First to investigate sexuality of plants scientifically. First to recognize importance of insects in pollination. First to produce hybrids.

SPRENGEL (1750-1816). Discovered dichogamy. Insects and pollination.

K. F. GARTNER (1772-1850). First intensive hybridizer of plants.

VAN HELMONT (1577-1644). Made first recorded experiment in plant physiology. Discovered that CO_2 turns lime-water milky.

HALES (1677-1761). "Vegetable Statiks." Laid foundation of plant physiology.

DU HAMEL (1700-1781). "Physique des Arbres."

INGEN-HOUSE (1730-1799). Established the difference between photosynthesis and plant respiration.

SENEBIER (1742-1809). All plants composed of the same elements, but in different proportions.

DE SAUSSURE (1767-1845). Developed quantitative experimentation in plant physiology. Nitrates and mineral matter necessary to normal nutrition. Showed necessity of chlorophyll and light to photosynthesis; that carbon is combined with elements of water in the process, and that respiration is necessary to growth. Showed that the greater bulk of the dry substance of plants is derived from the air instead of from the soil. Plants do not obtain nitrogen from the air.

WINOGRADSKI. Chemosynthesis. Nitrifying organisms of the soil.

TRAUBE. Cell growth. Osmosis

DUTROCHET (1776-1847). Compared respiration of plants and animals. First exact study of osmosis, and its importance for plant physiology. Tissue tension.

BEUSSINGAULT. Experimental plant physiology. Showed that nitrates are most suitable form of nitrogen supply.

KNIGHT. (1758-1838). Geotropism.

SACHS. Historian of botany. Founder of modern plant physiology.

FRANK. Plant pathology.

GRAY, ASA. American systematist and teacher.

DARWIN, CHARLES. Natural Selection. Plant physiology.

PASTEUR. Fermentation. Plant diseases.

MENDEL, G. Heredity.

HUXLEY (1825-1895). Theory of Evolution.

ENGELMANN, GEO. (1809-1884). American systematist.

THE BAMBOO HAT INDUSTRY.

E. S. ROMERO-TODESCO.

Broussonetia papyrifera (commonly called Moral papelero) grows plentifully in Spain, where it was introduced from Japan between the years 593 and 629; it is a source of considerable wealth, and is used for the manufacture of wood pulp. The shoots of this shrub are cut down about the month of November, when they reach the height of 2 or 3 metres. The wood pulp is converted into hats and other useful articles. Brazilian hats, made from the fronds of palmetto palms, also belong to the ever-increasing foreign hat industry, the fine "Panama" shapes of good quality being the masterpieces among woven hats. The bamboo hat industry is a growing one, and well-made bamboo hats are likely to be welcome for they are becoming, shady and cheap.—Gardeners' Chronicle.

SEED POTATOES.

The Irish Department of Agriculture recommends not only the planting of seed potatoes whole, the size of a hen's egg, but that these should be immature, being dug before the tops have dried off. The reason given for this is that, once maturity is reached, deterioration begins to set in, the dying of the tops being an evidence of this. By lifting the tubers before that stage is reached, deterioration is arrested and the seed tubers are obtained at the time of their greatest vigour. We have often pointed out the advantages of sprouting seed potatoes before planting. (See note on "Potato planting," in the pamphlet on Market Gardening issued by this Department.) Garden and Field for November, 1915, says that the advantages claimed for sprouting are:—(1) It increases the yield by 25 per cent.; (2) the crop matures earlier and can be lifted earlier; (3) sprouting enables planting to be done when conditions of weather and soil are most favourable, the sprouted seed being kept out of the ground for another week or two, if necessary, without detriment or actual loss of time; (4) there are fewer blanks, as no potato is planted that has not already started growth; (5) there will be less trouble from weeds, as the strong foliage developing from the sprouted seed chokes, or, at least, checks, weeds so much that they give very little trouble. Not more than two sprouts should be allowed to remain, and these should proceed from the rose end.

The difference in the results from sprouted and unsprouted seed was shown by an experiment made at the Queensland Agricultural College some years ago. A quantity of sprouted seed was selected from the barn, and planted; and at the same time an equal quantity of unsprouted tubers were planted on an adjoining plot. The first plot quickly appeared above ground with scarcely a miss; the other lot came up much later, in a straggly manner, and there were about as many misses as there were plants.—Queensland Agricultural Journal.

WHAT IS A NEW-LAID EGG?

One of the great mysteries of all time is now under investigation. The Board of Agriculture has recently been seeking among the trade to elucidate the problem. What is a new-laid egg?

A baffled, bewildered, and amused public has been suffered too long to flounder amid the terminological inexactitudes of the egg salesman. There are so-called "new-laid" eggs, "fresh" eggs, "good sized" eggs (a dubious definition which, like charity, may cloak a multitude of imperfections), and "reliable" eggs, to mention only a few titles in the catalogue, and there is no guarantee that one of them sheds the lustre of truth.

The nomenclature of the egg is, indeed, no easy affair. "A fertile egg laid by a hen in August," remarked a poultry expert, "may still be 'new-laid' at the end of two days, but if the weather be hot and the egg has been accidentally left in a warm cupboard it most certainly won't taste fresh. Now, what are you going to call that?"

Then there is the town palate. If street-bred people relish as fresh and new-laid an egg that is a fortnight old, why should the more sensitive country palate be allowed to condemn it, argue the experts further. These different tastes are, one is assured, a real factor in the situation.—Daily Mail.

LINSEED CULTIVATION.

TEMPLE A. J. SMITH.

New lands of good quality, either sandy loam, chocolate, or rich black loam, produce the greatest quantity of seed with the highest oil content. Sandy or gravelly soils are not desirable, neither are heavy clays. Good drainage is essential, as linseed does not like cold, wet conditions. The crop is especially suited to new land just broken up, and is useful for subduing such land for succeeding crops. New land is also free from the diseases which are liable to attack the crop.

Cool climates are best, and there are many districts in Victoria suitable, notably along the foot-hills in the north-east, Gippsland, the Western District, and central portions of the State. The northern and north-western portions, excepting where irrigation is possible, have rather too uncertain a rainfall.

Flax has the reputation of being hard on the land when grown for several years consecutively on the same soil, but this is due more to disease, or what is known as flax sickness, than to its effect on soil fertility. For this reason a judicious system of rotation cropping is especially necessary to insure successful linseed production. On old ground a crop of linseed should not be grown more than once in every four years, while some authorities claim that once in every seven years should be the course to adopt. In fixing a rotation system, it should be borne in mind that the crop follows peas, rye, vetches, and maize well, but it is not desirable to sow linseed immediately after exhaustive root crops, such as mangels. Where possible, it should be the first crop after the land has had a spell under pasture, and will not be found to affect the soil for succeeding crops to a greater extent than the usual cereals grown on the farm. The following analyses, showing the comparative demands made by wheat and flax, go to show that, with the exception of nitrogen and lime, flax takes considerably less than wheat of the food constituents required :—

20 bushels Wheat : Nitrogen, 25 lb. ; phosphoric acid, 20 lb.; potash, 35 lb.; lime, 8 lb.
15 bushels Flax : Nitrogen, 54 lb.; phosphoric acid, 18 lb.; potash, 27 lb ; lime, 16 lb.

PREPARATION OF THE LAND.

Linseed requires a very fine, firm seed-bed, and all possible care to eradicate weeds and get the land clean should be exercised. An early fallow in the autumn is especially valuable, in that it assists in cleaning the

land, and gives greater opportunity for making a good seed-bed. It will also be seen that the crop is a fairly heavy nitrogen feeder, and an early fallow will have the effect of supplying a sufficiency of this most essential plant food. On old land deep ploughing is necessary to obtain good results, and on loose, friable soils a heavy roller will compact the seed-bed, and provide better germination.

MANURES.

Artificial fertilizers are not much used for the crop, but there can be no doubt that they would be beneficial. Superphosphate, at the rate of 1 cwt. per acre, would just about supply an average crop with sufficient phosphoric acid for its development, while lime on soils naturally deficient should be applied at the rate of at least 5 cwt. per acre. Nitrogenous manures should not be required artificially if early fallowing has been practised, or a proper rotation followed, and on a poor soil 1 cwt to 1½ cwt. of potash would be advisable.

Farmyard or stable manure has a special value, in that it supplies humus in addition to the various plant foods contained, but care should be taken to use only well decomposed manure of this description; otherwise there is a liability of trouble from the seeds of weeds, grasses, etc.

The ploughing in of green crops, such as rye, pease, and clover on old land also has desirable results.

SEED.

Probably the chief reason for the low returns of linseed obtained in Victoria is due to the fact that varieties more suitable to produce fibre than seed have been grown. Where linseed is the object in view, only the seed best fitted to produce linseed should be used, and that of the very best quality. Too much stress cannot be laid on the importance of securing clean, bright, plump seed of varieties grown for seed only. Much attention has been given to this phase of the industry in North Dakota, United States of America, and the Argentine. Russia at one time was the chief source of supply, but improved methods of selection and treatment of the seed by the American growers appears to be ousting the Russian seed from its previous control of the market.

No. 3 Dutch "Rotterdam" seed is said to be one of the best varieties to grow, and the best of the American and Argentine would probably suit Victorian conditions. Fresh seed should be imported every second year, as a change of seed appears to be imperative after the second season.

Graded seed should be used, and before sowing it should be treated with a formalin solution of 1 pint of 40 per cent. strength in 45 gallons of water. This destroys the spores of the wilt-fungus, and actually benefits the seed. The best system is to sprinkle a heap of 8 or 10 bushels, and to keep turning the heap at the same time (half-a-gallon to each bushel is sufficient), and then cover with bags or a tarpaulin for a couple of hours; sow within twelve hours of treatment.

The rate at which the seed should be applied for linseed production is ½ to ¾ bushel per acre. For flax, more than twice this quantity is required.

The time to sow depends upon the season to some extent, as a warm seed-bed is of great importance. Autumn seeding, when the land is in good order, would suit mild districts, and spring sowing in the colder portions of the State which enjoy good rainfalls. The depth of seeding should not be more than half-an-inch, and the necessity for a finely cultivated seed-bed is here apparent, as in rough, cloddy land a uniform depth could not be maintained. Broadcast sowing is the most popular method, as the drill is liable to sow too great a depth on ridges or uneven land. After seeding the roller should follow to compact the soil round the seed to insure good germination; rolling is particularly necessary on friable, loose soils.

HARVESTING.

The crop is harvested for seed when the first seed-pods are browned and ready to open. The crop matures somewhat unevenly, but if cut with the binder at the stage mentioned, the greater pods will ripen on the straw. The sheaves must be stooked until dry enough to cart in and stack without danger of mildewing. A tarpaulin on the floor of the waggon used for carting in will save much waste, as the riper pods will shell easily when handled, and waste will occur unless precautions are taken to save the loose seed.

The crop can be threshed with a flail, or on a spiked roller, or through an ordinary cereal threshing machine. In the last-mentioned case, however, the fibre, if of any value, will be ruined. All linseed should be stored in a dry place, as it is easily destroyed by mildews.

DISEASES.

Flax wilt is the most common trouble, caused generally by the condition known as a flax-sick soil. This is a fungus disease which enters the young plant either from spores on the seed or in the soil. This fungus develops inside the tissues of the plant, causing it to die.

Clean seed, treated with formalin, sown on land free from the disease, is the remedy, and a long rotation in which linseed is cropped once in five to seven years.

Manure containing flax staw, or from animals fed on flax, should not be used.

Other fungus diseases yield to the same methods of treatment, and the crop is not subject to serious injury from insect pests.—Journal of Agriculture, Victoria.

AGRICULTURAL EDUCATION AND RESEARCH IN ENGLAND.

We open the latest report on Grants for Agricultural Education and Research wondering how the war is going to affect the liberal policy adopted in recent years by the Board of Agriculture. It is satisfactory to find that the Board means to continue on the high plane on which it started: economies there will have to be but the main lines are, for the present at least, to continue as before.

Perhaps the most important change during the year has been the framing of new regulations for the distribution of grants for agricultural education and research. Hitherto the grants have been paid in several different ways: in future there is to be more uniformity of procedure. When Government aid was first given to agriculture in the form of "whisky money," it was left to the local authorities to decide how they would spend the money. Some simply used it as a dole to the farmer and applied it towards the relief of the rates; others set up local schools; others, again, realising the need for higher work, set up colleges and aimed at having scientific investigations carried out.

As might have been expected, the war has had a serious effect on the agricultural colleges and research institutes. The best of their young men volunteered at once for military service. Some of the colleges were practically emptied, and the research institutes lost their most vigorous and enterprising workers, some, alas! never to return. But, to the credit of the Board, the principle that education and research must be kept going has so far been

successfully maintained, and although the grants are rightly reduced automatically as members of the staff enlist, there is no evidence from the report that any of the institutes and colleges have rendered valuable help in dealing with the special problems arising out of the war. It never was more necessary than now that farmers should have the best expert advice available, and it is gratifying to know that all concerned are doing their utmost to help in the emergency. Research institutes subsidized by Government are new things to the ordinary taxpayer, and a great responsibility devolves on them to justify themselves in the present emergency. If science can help agriculture, surely this is the time for doing so.—Nature.

SUNN-HEMP.

This crop is extensively grown in this and the neighbouring districts for fibre which is generally exported in large quantities. Although the demand for its fibre was much limited during the year under report owing to the war, yet a very large area is again put under this crop. The cultivators instead of supplying good, well retted fibre adopt a short-sighted policy of supplying unclean fibre full of dirt and straw to secure a slight increase in the weight in order to make a little more profit.

With a view to place a suitable variety of sunn-hemp at the disposal of the cultivators and to teach them the cheapest possible process of retting, the varietal experiments with this crop were started at the station in 1912 and 1913. The results obtained during the last two years proved very satisfactory and were much appreciated by the zamindars and cultivators of the neighbourhood. But during the year under report the experimental crops were damaged by water lodging owing to the heavy and constant rains. The results of the experiment are not therefore satisfactory.—Rept. on the Benares Agric. Stn.

DEEP CULTIVATION AND FOOD SUPPLY.

F. G. DREW.

One of the consequences of the war is that attention has been drawn to the necessity of increasing our home supplies of food and to the need for raising the standard of productiveness of the soil.

When reading some of the written opinions on the subject, however, one is inclined to suspect that the writers have either not given much attention to the economics underlying the question, or have had but little experience in the cultivation of the land.

Increased food production, whether by means of increase of area under cultivation in the case of land of low productivity, or by intensive methods tending to increase the productive power of the soil, means increase of capital (which may not be readily available) and of labour which at the present moment is very difficult to obtain.

Depreciation of the efforts of others is cheap enough, but it is not so easy to give practical suggestions, or suggestions that can be readily carried out with the effect of obtaining increased yield without reducing the margin of profit. There are few undertakings in which, as a whole, the margin of profit is more precarious than in the market gardening industry. The nature of most of the products precludes those means of preservation which are adopted with other kinds of food in order to balance the supply with the

demand. Hence, any grower, before putting further capital into his land in the shape of deeper tillage, must assure himself that such capital will return a reasonable amount of interest, which he himself will receive and not the next tenant or his landlord.

Cultivation is an operation which requires both time and money. The higher it is, the greater the outlay, and the longer the time required in which to develop it. Deficiency in the requisite capital, combined with the stern necessity for some immediate return, may delay, if not altogether prevent, the full development of potentialities.

A remark was once made within my hearing to the effect that one of the greatest factors in education is leisure. I believe it to be true. I think it is equally true with reference to the soil and cultivation. The term leisure I interpret as meaning comparative freedom from pressing economic considerations.

Some of us know by experience what may be accomplished in a few years with the most intractable and unpromising soil, where the circumstances permit, and when economic considerations are not paramount. Yet it can hardly be admitted that these methods altogether solve the problem.

It may be permissible to look upon some of the money spent in this way in the light of capital investment, but for the man who is compelled to get his living out of the soil deep cultivation, except that of a very rudimentary order, is out of question.

Radical improvement in the physical condition of heavy soil and sub-soils is for him a difficult problem. Yet this is precisely the kind of land which only unlocks its store of food and develops its latent fertility in proportion to the improvement in its physical condition effected by cultivation.

The advice, frequently given, to trench and put in two good layers of stable manure, or it may be one of manure and one of leaf-mould, is excellent when it can be carried out. Nothing will improve the texture of heavy land so quickly as liberal supplies of organic manure combined with frequent, deep and judicious working. But even then this treatment is required for a number of years in order to bring stiff agricultural land into the condition seen in the quarters of some of the vegetable gardens belonging to private establishments. And what of the cost? To begin with, it is almost impossible to-day to purchase any quantity of manure, except in a few particular areas, under 5*s*. to 6*s*. per load. These loads are usually considerably less than a ton in weight. As to applying two good layers, I find half a load to a pole or eighty loads to an acre is little more than a good sprinkle, and even this quantity is quite inadequate to bring about rapidly any great improvement in the texture of bad-working soils. On some of the heavy brick earths of Middlesex it was at one time by no means unusual to apply 120 tons to the acre when the market gardener first took them in hand; quite recently one man told me that if for any reason he missed manuring for a year, he increased the amount in the one following! What a chance for the deep spadesman!

Successful market gardening on a small scale, apart from the business aspect, is very largely a matter of securing a close succession of marketable crops. This means that no time must be lost in clearing, preparing and planting the land, and this postulates ease in and frequent opportunity for working, together with avoidance of the delays by weather, which are all too frequent where there is not a considerable depth of what may be termed more or less permanent tilth. The latter is a very different sort of thing from the shallow transitory kind which may be obtained on the heaviest of land by a patient cultivator of good judgment and ample means in a favourable season, but which in an unfavourable one may never be obtained at all except by missing a particular crop altogether. This raises the question of the suitability of this type of land for the smaller cultivator, but into that I cannot enter here.

Most of us are very well aware that many crops can be grown on heavy land with much smaller quantities of stable manure than those cited above. Some of us know, too, something of the evil effects of the texture of heavy soils of repeated dressings of some kinds of artificial manure.

But any cultivator whose heart is in his land—his head must necessarily be in his business—not only aims at producing good crops at a reasonable cost, but also at producing permanent improvement in the physical conditions of his soil.

From my own experience in dealing with heavy land just brought under cultivation—excepting such as has been good pasture—and with heavy land that has previously received only ordinary cultivation for agricultural crops, I have found that even eighty loads of manure to the acre would not permit of much, if any, being used in the bottom of the trench—presuming that trenching was possible—for the purposes of improving the condition of the sub-soil. It would as Mr. Brotherston hinted in a recent article, be more profitable—at any rate, for a few years—to use all available manure as near the surface as the nature of the crop permitted in order to break the tenacity of the top soil, and thereby render early working and early sowing possible.

By keeping the manure near the surface decomposition would take place more rapidly, and the possibility of manurial matter being washed down beyond reach of the roots would be greatly reduced. The fact that the roots of some crops do not penetrate deeply into well-broken but cold land is sometimes overlooked. It is in the infantile stages of growth when a good supply of finely-divided humus is most needed and when a deficiency may have the most disastrous effect on the crop. Further, a layer of manure some distance below the surface in a soil that has not been well worked down to a fine condition to the depth of the manure is apt to be so tenacious of moisture that it will not part with it readily to the soil above, and until the roots get down into the manure, crops are often seen to suffer though there may be ample reserves of moisture in the soil. This condition is not likely to arise in a soil long cultivated, but frequently occurs on freshly-broken ground.

In my own case, and when using manure in autumn in half-decayed condition, I have frequently had it spread over or immediately under the surface, and harrowed in during early spring. This method gave better results, both as regards crops and quality of tilth, than in other instances where the manure was buried in the usual fashion, during the process of digging.—Gardeners' Chronicle.

THE POISONOUS FORMS OF *PHASEOLUS LUNATUS* (THE LIMA BEAN).

W. R. DUNLOP.

INTRODUCTORY STATEMENT.

The following review of our present knowledge of the poisonous nature of *Phaseolus lunatus*, though not embodying the results of an experimental enquiry by the writer, has been written with a definite object connected with the present work of the Department. The object is to provide Agricultural Officers and planters, who have been induced through the efforts of the Imperial Commissioner of Agriculture to give increased attention to the cultivation of this food crop in the West Indies, with as clear a statement as possible of the conditions under which prussic acid may be developed in the seeds of some forms of this species.

To remove at the outset any feelings of misapprehension or alarm, it may be stated that only the coloured beans of certain wild or semi-wild forms of *P. lunatus* have been found to contain prussic acid in dangerous proportions. The white beans usually produced under cultivation in America and the West Indies are entirely harmless; a large trade in them exists, and they constitute an important and recognized article of food. It has occurred to the writer, however, that it is important in face of an almost complete absence of definite information, to learn something concerning the transmission of the poisonous characteristics if only to guard against any possible reversion of the white bean through hybridization. Apart from this consideration, it would be useful in the selection of the coloured varieties, and of no little interest from a scientific aspect. To emphasize the need for this work constitutes a second object of the present paper. Some of the work that has been done on *P. lunatus* points to the soil as a factor to be reckoned with, affecting at any rate the production of prussic acid. If this is so in the case of colour, it is a striking exception to the general rule established by workers in genetics. Experiments recently conducted at Mandalay, Burma, with different forms of Rangoon beans (*P. lunatus*) have not given conclusive results. Indeed, one may almost with safety dismiss the idea of soil influence. Nevertheless, the point having been raised, the present writer has in hand a series of experiments designed to show whether any indication of a change of colour or prussic acid content is made manifest by growing plants from white seeds in unfertile soils. Opportunity will be taken at the same time to examine the mode of pollination. It is also hoped that crossing experiments between white and coloured seed-producing plants may be carried out in order to arrive at some idea of the mode of transmission of the characteristics as suggested above. Most of the work on *P. lunatus* has been almost entirely of a chemical nature, except, perhaps, in the Southern United States where, however, sectional work probably began with a South American strain of Lima bean from which the prussic acid producing propensities had doubtless already been partly eliminated in Peru. With our tropical strains there is urgent need for botanical investigation. Work along this line, but with reference to improvement rather than to analysis, will doubtless suggest itself to those interested commercially in the Lima bean in the different colonies of the West Indies.

BOTANICAL AND ECONOMIC FEATURES OF *P. LUNATUS*.

Phaseolus lunatus belongs to a large genus of the Leguminosæ-Papilionaceæ, all of whose species are natives of warm climates. *P. lunatus* is apparently wild in tropical America, as well as in tropical Africa and Asia, but so generally cultivated in hot climates that it is difficult to ascertain its origin. De Candolle believes it to be a Brazilian species. It is very like the common French bean in general aspect, but the flowers are much smaller and more numerous; and the pod is flat, short, broad and somewhat crescent-shaped, with only two or three seeds. Griesbach describes the stems of specimens from the West Indies as usually twining, the leaflets as ovate pointed, calyx 4-toothed much longer than the bracteoles and spirally twisted, flowers greenish white, and seeds purple or white.

These are the principal specific characters, but it has to be remembered that there exist a large number of different varieties in various parts of the world. Commercially these are known under different names. In the English market, Java, Mauritius, Madagascar and Rangoon beans are all the products of varieties or strains of *P. lunatus*. Towè beans of Sierra Leone, and the Bush bean of Australia also belong to the same species. In the new world, Lima bean is the popular name. Many others are recorded in different places, but they all appear to be the product of *P. lunatus*. The

Imperial Institute, which has given much attention to *P. lunatus*, recently classifies the commercial beans into four groups :—

(1) *Java beans.*—Medium sized on the flat, somewhat shrivelled, varying in colour from purplish-red to nearly black. A few white beans are sometimes intermixed. This group contains considerable quantities of prussic acid.

(2) *Red Rangoon beans.*—Small reddish beans which are usually plump, and occasionally show purplish spots. This class contains traces of prussic acid.

(3) *Small white beans.*—Plump and resembling 'small haricots.' Generally contain mere traces of prussic acid but occasionally larger quantities.

(4) *Lima beans.*—These resemble 'large haricots' and are quite white and contain no prussic acid.

Nos. 3 and 4 doubtless correspond to the Sugar and the Lima bean as cultivated in the West Indies and elsewhere.

W. W. TRACEY, of the United States Department of Agriculture, gives the following classification of the Lima bean :—

Phaseolus lunatus (*Lima bean*).—Leaves pinnately trifoliate, the terminal leaflet present; seeds with more or less pronounced veining and flat to oval flat, flowers small or not ⅝-inch across the wings; roots fibrous; pods not edible at any stage of development

Plants, bush: (a) seeds flat and large.
(b) seeds flat and small.
(c) seeds thick and large.

Plants, pole: (a) seeds flat and large.
(b) seeds flat and small.

Under these five sub-headings are enumerated the different commercial varieties on the American market.

Apparently the bush and pole varieties of the United States correspond to Nos. 3 and 4 of the Imperial Institute commercial classification.

As regards the selection of varieties, the most extensive work has been done in the United States (California) where high-yielding strains of Limas have been produced.

It is significant that none of the United States' publications on the selection and improvement of the Lima bean refer to the poisonous properties of this species. The probable reason is the complete absence of prussic acid in any of the strains or varieties cultivated in that country. If these have existed, climatic conditions may have exercised an influence on the disappearance of the prussic acid in the seeds, or more probably the selection of the beans would have eliminated the cyanogenetic property owing to the correlation existing between this and colour. The objections to colour from the commercial standpoint would also have no doubt been partly responsible.

Work has recently been undertaken in India to improve the local strains, and considerable progress is anticipated, both as regards increase of yield and elimination of poisonous properties. Reference will be made to work again later when considering the factors influencing the production of prussic acid.

HISTORY OF THE POISONOUS EFFECTS OF *P. LUNATUS*.

The poisonous action of the beans of *P. lunatus*, resulting in several fatalities, had been observed for many years before the nature of the action received careful investigation. WATT in the DICTIONARY OF ECONOMIC PRODUCTS OF INDIA (1890) calls attention to the marked poisonous characters sometimes

exhibited, and VAN ROMBURG, in 1897, referred to their toxic nature in the island of Réunion, and actually indicated the presence of prussic acid. For many years cases of cattle poisoning as the result of eating the beans had been recorded in Mauritius, and BONAME also detected prussic acid in the seeds. During 1898, samples of these Mauritius beans were sent to the Imperial Institute, London, for investigation, and the complete chemical elucidation of the nature of the poisoning was achieved by DUNSTAN and HENRY and published by them in 1903. According to DE SORNAY, however, BONAME holds priority in this matter except that DUNSTAN and HENRY are responsible for the exact determination of the prussic acid-producing substances.

It is of historical interest to record the fact that several years after this, a case of poisoning from the consumption of the beans was reported from Ceylon. This fatality was due to consumption of the bean shown by DUNSTAN and HENRY to be dangerous. Quite recently, however, the Director of Agriculture in Sierra Leone has stated that coloured beans, identified at Kew as *P. lunatus*, and reported as dangerous by the Imperial Institute, are much appreciated by the natives, and no cases of illness have been heard of. It is quite certain that a great variation exists in the extent to which the different coloured strains of *P. lunatus* can produce poisonous effects. This is a point which requires further investigation.

NATURE OF THE POISONOUS PROPERTIES—CYANOGENESIS.

In the course of that which has so far been stated, reference has been made somewhat loosely to the prussic acid content of *P. lunatus*. It would be more accurate to speak of the capacity for producing prussic acid, since this poison does not exist in the beans in a free state. As already stated, the subject has been thoroughly investigated by DUNSTAN and HENRY, who have found that when the beans belonging to the class already described are crushed and moistened with water, prussic acid is produced in considerable quantities. The same phenomena had been observed and explained previously in the case of the Egyptian fodder plants *Lotus arabicus* and *Sorghum vulgare*. It was known for many years to exist in the case of the bitter almond and cassava. To denote the chemical change which takes place in the moistened material, DUNSTAN and HENRY suggested the term cyanogenesis. Briefly this consists in the interaction in the plant of a glucoside and a ferment simultaneously present. Prussic acid does not exist in a *free* state, but is rendered available from the glucoside (containing hydrocyanic acid = prussic acid) through the splitting up action of the ferment in the presence of moisture. Amongst plants there are several glucosides and ferments capable of giving rise to prussic acid, but in the seeds of *Phaseolus lunatus* the formation of the acid is attributed to the glucoside phaseolunatin which is split up by the enzyme emulsion producing dextrose, acetone and hydrocyanic acid. Curiously, the same two substances are responsible for prussic acid formation in cassava.

One of the most interesting results of this investigation was the establishment of a correlation between prussic acid production and colour. This has already been referred to in describing the different kinds of beans. It will have been gathered that as a general rule *P. lunatus* produces seeds which vary in colour in proportion to the extent to which the plant has been subjected to cultivation; while under partial cultivation the seeds are usually light brown or pink with a few purple spots, and when thoroughly cultivated they become much larger, and the colour changes to a pale cream tint. Coincident with these changes of colour in the seed coat, the toxicity of the seeds tends to decrease in cultivation. The selected white beans are therefore always quite harmless. It appears, however, to the writer that this correlation is not quite as definite as DUNSTAN and HENRY at first believed.

This can be seen from their later classification given earlier in this paper, and from the selection work in Mandalay. Moreover, GUIGNARD detected the poisonous principle in practically all the varieties of *P. lunatus* whether wild or cultivated, though the quantity was almost inappreciable in the seeds of the improved forms like the Lima bean.

FACTORS INFLUENCING THE TOXICITY OF THE SEEDS.

SCURTI and TOMMASI, of the Rome Agricultural Chemical Experiment Station, have investigated the effect of manures on the composition of the seed of *Phaseolus vulgaris* (the French bean) and *P. multiflorus*. They found that the application of nitrate to the soil decreased the amount of non-protein nitrogen in the beans. If this non-protein nitrogen be taken as a measure of toxicity, it would appear that a rich soil tends to reduce the alkaloid content of seeds—a phenomenon which in fact has been observed in the case of medicinal plants. TREUB has stated that nitrates exert a direct influence on the production of hydrocyanic acid. It would appear from this that the soil may have some influence in regulating the glucoside content of the seeds of *P. lunatus*. Against the hypothesis that a rich soil reduces the poisonous content, we have the results obtained by BRUNNICH in Queensland, who found that the poisonous properties of *Sorghum vulgare* increased with improved fertility. At the same time it must be remembered that in one case it is the seed of a plant that is considered and in the other the leaves and the stem.

Recent work in Burma tends to indicate that the soil plays some part in determining the colour of the seeds of *P. lunatus*. In Mandalay, at the Agricultural Station, dark-coloured seeds were sown, and those which were reaped were of a lighter colour. This may have been due to cross-fertilization. These experiments indicate that the colour correlation is by no means complete, for some selected seed of light colour (but not white) produced more prussic acid than those selected of darker colour. On the other hand, the reverse case was also observed in some instances, so that the results are not conclusive.

It is more than probable that the production of non-poisonous white seed has been almost entirely the result of selection, and it would be better to say that the toxicity of coloured beans decreases under the influence of selection rather than cultivation, which is not generally taken to mean the former.

In putting forward the explanation of cyanogenesis, it cannot be too strongly emphasized that the cyanogenetic glucoside and the enzyme are complementary as regards the production of prussic acid. If one is absent no poison can be formed. But this does not mean that one compound cannot exist without the other. Very probably it can. And it seems to the writer an important matter to decide whether some strains of *P. lunatus* beans may not contain the glucoside without the enzyme, and others the enzyme without the glucoside. If this does happen, each kind would by itself be harmless, but if mixed, would present the same danger as if both compounds were contained in the same seed. Possibly the case of the Sierra Leone beans proving harmless may be an example where the glucoside exists without the enzyme.

Turning to consider the possibility of removing the poisonous nature of coloured seeds by the application of heat, it has been found that this treatment does remove the power of the crushed seed to produce prussic acid afterwards in the presence of moisture. This, however, does not necessarily mean that the material is rendered harmless, since the effect of the heat is to destroy only the enzyme or ferment. It is quite possible that other vegetable foods may be consumed along with the beans, which may contain a ferment capable of performing the functions of that which was destroyed. This

argument is especially tenable in the case of live-stock, which ordinarily consume large quantities of green fodder. In the case of human consumption the danger is much less. It may be laid down that natural absence of the enzyme, and occasionally high acidity of the stomach (which tends to prevent the formation of hydrocyanic acid) are the principal factors which explain recorded instances in which people and animals have consumed appreciable quantities of coloured beans of *P. lunatus* without subsequent illness or fatality.

SUMMARY AND CONCLUSIONS.

Phaseolus lunatus is the origin of many different kinds of tropical beans, some of which are edible, while others can be consumed only with danger. The poisonous principle is prussic acid, and although the production of this compound in seeds from cyanogenetic glucosides has been carefully investigated, our botanical knowledge of the subject is not yet sufficiently complete to allow of the statement that there is a definite coincidence between the presence of poison and colour, nor are the chemical facts sufficient to show whether the glucoside may not occur without the ferment in some cases, and vice versa. In spite of certain observations to the contrary, it is not considered likely that the soil has any fundamental influence upon the poison content or colour of the beans. The principal influence is probably artificial selection. Up to the present it is possible to state definitely two things : (a) that the dark purple or black bean (the Java bean) is dangerously poisonous, and (b) that the creamy-white Lima bean is perfectly wholesome. The cultivation of forms of this latter kind are being advocated officially in the West Indies, and an object of the preceding paper has been to remove any feelings of misapprehension. Another object has been to indicate the opportunity for further investigation, especially in regard to cross-fertilization. It has yet to be discovered what botanical relationship exists between colour and the presence of poison.

NOTE.

Those interested in the subject agriculturally may wish to know of a convenient test for prussic acid. The following was used by Professor Guignard of Paris :—

Filter paper is moistened with 1 per cent. picric acid and dried, then moistened with 10 per cent. sodium carbonate and dried, in which state it keeps its sensitiveness for several months. A strip suspended in a test tube containing 0·02—0·05mg. HCN becomes red-orange in twelve to twenty-four hours.—West Indian Bulletin.

THE WATTLE BARK INDUSTRY OF NATAL.

In the Report of the Durban Chamber of Commerce for 1914 it is stated that the Natal wattle-bark trade has suffered a check by reason of the war. The exports for the first seven months of 1914 amounted to 47,663 tons, as compared with 39,899 tons in the corresponding period of the previous year; but the total amount exported in 1914 was only 58,132 tons valued at £286,399, as compared with 65,042 tons, valued at £309,268, in 1913. Had conditions been normal, it is stated, the exports for 1914 would have exceeded those of 1913.

The wattle-tree thrives so well in Queensland, that it appears surprising that a large business in the wattle-bark industry has not long since been built up. At one time small quantities of wattle bark were obtained, principally about Dalveen; but of late nothing has been heard of an industry which brings in from £286,000 to £309,000 per annum in South Africa.—Queensland Agricultural Journal.

POTASH CONTENT OF PLANTS.

In a lecture delivered by Mr. R. D. Anstead, m.a., to the United Planters' Association of Southern India, some interesting figures are given in regard to the potash content of certain plants used as green dressings and as mulches. *Tephrosia purpurea* contains 24 per cent. potash in its ash, while Albizzia prunings contain 22'8, Casuarina only 4'9, while *Leucæna glauca*, 25'1. It is interesting to note that coconut husk contains as much as 47'0 per cent. of potash in its ash, whereas the shell contains 26'5 per cent., and leaves only 1'1 per cent. The lecture referred to is published in the Planters' Chronicle for August 28, 1915.—Agricultural News.

CHICORY.

On our arrival in Flanders in July last the principal crops one noticed were Wheat, Sugar Beet, Potatoes, Chicory, Hops, Oats, Barley, Turnips, Cabbage. The order in which they are named is a rough indication of their frequency.

As a Coffee planter, naturally I was most interested in chicory. This pernicious weed is cultivated as a field crop. It grows like a straggly cos lettuce. The leaves are sometimes bleached and eaten as a salad but are too bitter to suit the average British palate. It tastes like endive. The roots are large and forked, something like a big parsnip. The chicory is one of the last crops to be harvested and the roots are left in the ground till late autumn. The tops are then cut off with a sickle and left on the ground as a green manure and the roots are ploughed out, collected and carted to a drying shed, sometimes the same building as the hop kilns. There they are freed from adhering earth, and chopped into squares, about 2 inches.

These bits are then put into a circular, rotary Roaster, which revolves over a charcoal fire till the contents are so dry as to be easily ground up. While the process of roasting goes on the most revolting smell issues from the machine, which is the fumes off the burning chicory. The stuff is now ready to ruin the taste and flavour of our fine products, and a decent cup of coffee seems unprocurable in this unhappy country.

Owing to the war, many thousand acres of chicory were not harvested in the autumn of 1914, especially in the Salient and further South. Round St. Eloi I have seen it running up to seed about 4 feet high. A pretty blue, cornflower like flower grows up the stem. In this state it makes fine cover for game, and one constantly sees pheasants, partridges, rabbits, and hares in it.

I would like to see some scientist make a study of the land in the immediate neighbourhood of the trenches after the War to see if the constant shocks by high explosives have had any effect on the productiveness of the soil, beneficial or otherwise. A good deal used to be said about the benefits to be derived from the use of dynamite in soils, and this seems a good chance of seeing what the result may be.—J. A. in The Planters' Chronicle.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.)

	QUALITY.	Quotations.
ALOES, Socotrine cwt.	Fair to fine	40/ a 50/
Zanzibar & Hepatic ,,	Common to good	40/ a 70/
ARROWROOT (Natal) lb.	Fair to fine	5d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£7 10/ a £7 15/
East Indian, bleached ,,	Fair to good	£8 10/a £8 12/6
,, unbleached ,,	Dark to good genuine	£6 5/ a £7
Madagascar ,,	Dark to good palish	£7 15/ a £8 2/6
CAMPHOR, Japan lb.	Refined	1/7 a 1/8
China cwt.	Fair average quality	155/
CARDAMOMS, Tuticorin	Good to fine bold	5/9 a 6/
per lb.	Middling lean	4/8 a 5/4
Malabar, Tellicherry ,,	Good to fine bold	5/9 a 6/3
Calicut ,,	Brownish	3/9 a 5/3
Mangalore ,,	Med Brown to good bold	4/ a 6/4
Ceylon, Mysore ,,	Small fair to fine plump	4/ a 6/4
Malabar ,,	Fair to good	3/2 a 3/4
Seeds, E. I. & Ceylon ,,	Fair to good	4/ a 4/3
Ceylon "Long Wild" ,,	Shelly to good	2/3 a 3/6 nom.
CASTOR OIL, Calcutta ,,	Good 2nds	3½d
CHILLIES, Zanzibar cwt.	Dull to fine bright	50/ a 60/
Japan ,,	Fair bright small	60/ a 70/
CINCHONA BARK.—lb.	Crown, Renewed	3⅜ d a 7 d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1⅜ d a 4½d
	Renewed	3d a 5½d
	Root	1¼d a 4d
CINNAMON, Ceylon 1sts.	Good to fine quill	1/3 a 1/9
per lb. 2nds.	,, ,,	1/2 a 1/7
3rds.	,, ,,	1/1 a 1/6
4ths.	,, ,,	1/ a 1/3
Chips.	Fair to fine bold	2d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	1/ a 1/2
Amboyna ,,	Dull to fine	10d a 10½d
Zanzibar ,,	Fair and fine bright	5¾d a 6¼d
Madagascar ,,	Fair	7d
Stems ,,	Fair	2d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian ,,	Fair to bold	63/ a 80/
COCOA, Ceylon Plant. ,,	Special Marks	81/ a 88/6
	Red to good	73/ a 80/6
Native Estate ,,	Ordinary to red	42/ a 68/
Java and Celebes ,,	Small to good red	30s a 93s
COLOMBO ROOT ,,	Middling to good	15/ a 22/6
CROTON SEEDS, sifted,,	Dull to fair	42/6 a 47/6
CUBEBS ,, ,,	Ord. stalky to good	130/ a 150/
GINGER, Bengal, rough ,,	Fair	19/
Calicut, Cut A ,,	Medium to fine bold	75/ a 85/
B & C ,,	Small and medium	35/ a 74/
Cochin, Rough ,,	Common to fine bold	22/6 a 27/
	Small and D's	20/
Japan ,,	Unsplit	20/
GUM AMMONIACUM ,,	Ord. Blocky to fair clean	40/s a 72s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
,,	,, ,, little red	£11 a £12
,,	Bean and Pea size ditto	70/ a £11
,,	Fair to good red sorts	£8 10/ a £10 10/
,,	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar ,,	Fair to good palish	£4 a £8
,, ,, red		£4 a £7
ARABIC, E. I. & Aden ,,	Ordinary to good pale	26/ a 32/6
Turkey sorts ,,	,, ,,	37/ a 57/6
Ghatti ,,	Sorts to fine pale	17/ a 27/
Kurrachee ,,	Reddish to good pale	22/6 a 32/6 nom.
Madras ,,	Dark to fine pale	20/ a 30/ nom
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£6 a £6 10/
	com. stony to good block	40s a £5
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	57/6 a 67/6
Somali ,,	,, ,,	52s 6d a 55s
OLIBANUM, drop ,,	Good to fine white	45s a 50s
,,	Middling to fair	35s a 40s
pickings ,,	Low to good pale	15/ a 27/6
siftings ,,	Slightly foul to fine	18s a 25s
INDIA RUBBER lb.	Fine Para smoked sheets	2/4
Ceylon, Straits, ,,	Crepe ordinary to fine	2/2½
Malay Straits, etc. ,,	Fine Block	2/4¾
	Scrap fair to fine	1/8 a 1/9
Assam ,,	Plantation	1/10
,,	Fair 11 to ord. red No. 1.	1/3 a 1/6
Rangoon ,,	,, ,, ,,	1/2 a 1/4

	QUALITY.	Quotations
INDIA RUBBER lb.		
Borneo ,,	Common to good	9d a 1/3
Java ,,	Good to fine red	1/3 a 1/6
Penang ,,	Low white to prime red	9 d a 1/4
Mozambique ,,	Fair to fine red ball	1/9 a 2/1
,,	Sausage, fair to good	1/9 a 2
Nyassaland ,,	Fair to fine ball	1/9 a 2
Madagascar ,,	Fr. to fine pinky & white	1/4 a 1/6
,,	Majunga & blk coated	1/ a 1/2
,,	Niggers, low to good	6d a 1/6
New Guinea ,,	Ordinary to fine ball	1/4 a 1/7
INDIGO, E I. Bengal ,,	Shipping mid. to gd., violet	3s 3d a 3s 8d
,,	Consuming mid. to gd.	2s 9d a 3s 2d
	Ordinary to middling	2s 4d a 2s 9d
,,	Mid. to good Kurpah	1s 11d a 2s 5d
,,	Low to ordinary	1s 6d a 1s 9d
,,	Mid. to fine Madras	1/11 a 2/9
MACE, Bombay & Penang	Pale reddish to fine	2/4 a 2/6
per lb	Ordinary to fair	2/ a 2/2
Java	,, ,, good pale	2/ 1 a 2/4
Bombay	Wild	1/
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57's	9½d a 10½d
	80's	7½d
	110's	6½d
NUTS, ARECA cwt.	Ordinary to fair fresh	17/6 a 20
NUX VOMICA, Cochin	Ordinary to good	13/6 a 15
per cwt. Bengal	,, ,,	12/
Madras	,, ,,	12/ a 13/
OIL OF ANISEED lb.	Fair merchantable	5/2
CASSIA ,,	According to analysis	2/8 a 2/11
LEMONGRASS oz.	Good flavour & colour	2½d
NUTMEG ,,	Dingy to white	1½d a 1⅝d
CINNAMON ,,	Ordinary to fair sweet	4d a 1s 5d
CITRONELLE lb.	Bright & good flavour	1/6½
ORCHELLA WEED—cwt		
Ceylon ,,	Fair	10/6
Madagascar ,,	Fair	10/6
Zanzibar ,,	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	5d
Ceylon ,, ,,	Fair to fine bold heavy	5d a 5⅝d
Singapore ...	Fair	4¾d
Acheen & W. C. Penang	Dull to fine	5d a 5½d
(White) Singapore ,,	Fair to fine	8½d a 8¾d
Siam ,,	Fair	8½d
Penang ,,	Fair	7⅞d
Muntok ,,	Fair	9d
RHUBARB, Shenzi ,,	Ordinary to good	2/ a 4/
Canton ,,	Ordinary to good	1/10 a 3/6
High Dried,,	Fair to fine flat	11d a 1/1
	Dark to fair round	9 d a 10d
SAGO, PEARL, large--cwt	Fair to fine	18/
medium ...	,, ,,	16/
small ...	,, ,,	13/ a 14/
Flour ...	Good pinky to white	10/ a 11
SEEDLAC cwt.	Ordinary to gd. soluble	65/ a 75/
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 8½d
	Fair greenish	3d a 4½d
	Common specky & small	1⅛ d a 2½d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	72/6 a £6
Bombay ,,	,, ,,	85/ a £6 10/
Mergui ,,	Chicken to bold	£8 12/6 a £145
Manilla ,,	Fair to good	£7 17/6 a 13 10
Banda ,,	Sorts	50/ nom.
Green Snail ,,	Small to large	70/ a 85/
Japan Ear ,,	Trimmed selected small to bold	47/ a £5 15
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	14/ a 15/
per cwt. Madras	Inferior to good	6/ a 10
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	12/ a 26/
	Pickings	6/6 a 19/
TURMERIC, Bengal cwt.	Fair	12/ a 13/
Madras ,,	Finger fair to fine bold	14/ a 16/
Do. ,,	Bulbs ,, ,, [bright	12/ a 13/
Cochin ,,	Finger fair	13/ nom.
	Bulbs ,,	11/6 a 12/
VANILLOES— lb.		
Mauritius ... 1sts.	Gd. crystallized 3½a 8½ in.	9/6 a 15/
Madagascar ... 2nds.	Foxy & reddish 3½a ,,	9/ a 12/
Seychelles ... 3rds.	Lean and inferior	9/ a 9/6
VERMILLION ... lbs.	Fine, pure, bright	2/7
WAX, Japan, squares cwt.	Good white hard	47/6

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